THE SNAKES OF CEYLON

COLONEL F. WALL,
C.M.G., I.M.S.

GEORGE WALL

1820 – 1894

OPHIDIA TAPROBANICA

OR THE

SNAKES OF CEYLON.

NOTICE.

THIS publication is issued from the Colombo Museum, and copies can be obtained by applying to the Director, Colombo Museum.

JOSEPH PEARSON,
Editor.

COLOMBO:
H. R. COTTLE, GOVERNMENT PRINTER, CEYLON.

1921.

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OPHIDIA TAPROBANICA

OR THE

SNAKES OF CEYLON.

By FRANK WALL, C.M.G.,

Corresponding Member of the Zoological Society of London,
Honorary Correspondent of the Zoological Survey of India,
Fellow of the Linnean Society of London,
Fellow of the Asiatic Society of Bengal.

Colonel, Indian Medical Service.

Author of "The Poisonous Terrestrial Snakes of Our British Indian Dominions (including Ceylon)."

COLOMBO :

H. R. COTTLE, GOVERNMENT PRINTER, CEYLON.

1921.

THIS WORK IS DEDICATED IN AFFECTIONATE REMEMBRANCE TO

MY FATHER,

THE LATE

GEORGE WALL

(1820 TO 1894).

RECIPIENT OF THE COBDEN GOLD MEDAL FOR PHILANTHROPY,
FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY OF LONDON,
FELLOW OF THE LINNEAN SOCIETY OF LONDON,

WHO DEVOTED MANY LEISURE HOURS OF A LONG AND BUSY LIFE
TO THE INTERESTS OF CEYLON.

FOR MANY YEARS MEMBER OF THE LEGISLATIVE COUNCIL
OF CEYLON.

VICE-PRESIDENT OF THE CEYLON BRANCH OF THE ROYAL
ASIATIC SOCIETY, CHAIRMAN OF THE PLANTERS'
ASSOCIATION OF CEYLON, MEMBER OF THE
MUNICIPAL COUNCIL OF COLOMBO.

OBITUARY NOTICE OF THE LATE GEORGE WALL.

(*Extract from the "Ceylon Independent," Saturday, December 22, 1894.*)

George Wall is dead. What a depth of meaning is contained in those words can only be appreciated by those who, like him, have become as it were a part of Ceylon itself. The name of George Wall was a household word in Ceylon, and by his death a landmark is removed, a link connecting the present with the past. He was a monument of energy, perseverance, and unswerving loyalty to those in authority, and made for himself a name which has become written in imperishable letters in the history of the Colony. The Government of Ceylon has lost one who was at once a trusty ally and a determined opponent, one who had the courage of his convictions, and who maintained them at times against overwhelming odds, one who was never afraid to speak his mind and to do what he believed to be his duty whether it was on the side of the Government or on the side of the people. The public of Ceylon have lost a true and faithful champion, a patriot to the backbone ; the world of Science and Literature has lost a bright and shining light, and we a gentle master, a ready counsellor, and a true friend.

To attempt to write an adequate obituary of George Wall would be to attempt to record the history of Ceylon. He was born in the early days of British Government in this Island, he came out to it when it and he were in their prime, he grew

up with it as it were side by side, shared in its sorrows and its joys, and has died at a time when it is once more regaining a stability, with which he has had much to do, and now, after devoting his life to the land of his adoption, he has returned to his native land, only to die, fortunately however, surrounded by the members of his family. It is a history that we of a younger generation would do well to ponder over. A life devoted to the country in which he lived, a life of devotion, alike when in affluence and poverty, in health or in sickness. Of this phase of his character we are, perhaps, better able to speak than any one else. For six years he laboured as Editor of this journal, and the longer we had an opportunity of witnessing his indomitable courage and energy, his deep erudition, and the brilliancy of his marvellous intellect, the more were we bound to respect him. Nothing but the most serious illness would keep him away from his desk at office, and it was only under the most pressing orders of his doctors, and the earnest persuasion of his colleagues, that he was induced, eighteen months ago, to go up to Nuwara Eliya, where it was hoped that the invigorating climate would give him a longer lease of life. Even while in the hills he directed and controlled the policy of the paper he loved so well while it was being published 130 miles away, and the amount of work he got through in that lonely cottage in the sanitarium cannot be appreciated by any one more than it was by the staff of this paper. As regularly as the postman made his appearance, there came a budget of manuscript from Mr. Wall, invariably accompanied by a letter full of the most valuable advice and encouragement, occasionally blended with a kindly-put criticism, which was always deserved. Never was there a firmer or kindlier head of a department. His vast experience in life had taught him a knowledge of the ways of men and things that he well knew how to use:

We hardly as yet realize the loss we have sustained, neither we fancy can Ceylon itself. As a public man George Wall was unique. There were, of course, times when his opinions and his advocacy of them were not appreciated as he would have liked them to have been, but even his opponents could not but admire his pluck and the determined way in which he fought.

In controversy, as in everything else, he was a gentleman to the backbone, and even in the heat of debate he treated his opponents with an old-time courtesy which even they could not fail to appreciate. His arguments were always sound, he never adopted them unless he could quote chapter and verse in their support, and he had a way of putting them forcibly and to the point. The Government often looked to him for counsel and advice—successive Governors have been compelled to acknowledge his great ability in the solution of political difficulties—and the graceful courtesy Sir Arthur Havelock paid him, by calling on him, in full state, to inquire as to his condition, when lying, as it was thought, hopelessly ill at Dr. Kynsey's residence, was evidence of the respect entertained for him by the highest gentleman in the land.

George Wall was born in England in the year 1820. Eighteen years later he entered the great engineering firm, presided over by Sir (then Mr.) Joseph Whitworth. Here he showed such application to work and ability that within eight years he was made a junior partner. Considerations of health soon after compelled him to seek a kindlier climate than that of England, and he came to Ceylon in 1846 to manage a group of estates belonging to the Ceylon Plantations Company. For some years he resided in Kandy, and in 1854 the firm of Geo. Wall & Co. came into existence in Colombo, his partners at that time being, we believe, Messrs. Harvey and Mackenzie. The coffee enterprise was then at the height of its prosperity, and for a very long time Geo. Wall & Co. enjoyed a most prosperous career. Our readers will remember how with the failure of coffee came the downfall of that remarkable house. At the present time, however, we have to do with the man himself, the master mind which for so many years directed, not only the great business which bore his name, but also, to a very great extent, public opinion in Ceylon.

At a recent memorable gathering in Kandy Mr. Wall was described as the founder of the Planters' Association. This he no doubt was, and for some years he enjoyed the distinction of being Chairman of that august body. This was followed by a seat in the Legislative Council, a position he filled with the most conspicuous success, bringing to bear on all his work

that remarkable ability which ever characterized him. Then came the great League, when Mr. Wall—" Granite Wall " as Lorenz used to call him—together with Lorenz himself, Sir Harry (then Mr.) Dias, and all the Unofficial Members of Council, resigned in a body, leaving Sir Hercules Robinson, the then Governor, in a sore state of perplexity. This was many years ago, but though frequently invited, Mr. Wall never again accepted a seat at the Legislative Board, although always ready to give the Government the benefit of his experience and matured wisdom on matters affecting the welfare of the country.

The story of the "League" is such an important one, and the part played in it by Mr. Wall so characteristic of the man, that we purpose in another issue to give as full a description of the agitation as the facts at our disposal will allow. We could not possibly do justice to it in this brief sketch.

In 1868 there was a serious rice famine, and it was mainly through Mr. Wall's endeavours that arrangements were made for distributions of rice amongst the starving population. It was at his own mills—Bloemendahl—that these distributions took place. It may give an idea of the size of these mills, which were built under Mr. Wall's direction, when we say that there were daily employed there at that time upwards of six hundred hands.

It is not generally remembered that Colombo owes its Breakwater in a great measure to him. It was, we believe, intended to build the Breakwater at Galle, but, mainly through Mr. Wall's opposition, it was eventually constructed here. In the agitation for a Northern Arm and Dry Dock, Mr. Wall's powerful pen had doubtless very great weight with Government.

In the matter of the Paddy Tax he laboured long, and with the most conspicuous success. Thanks to the warm advocacy of Sir Arthur Havelock, Mr. Wall's arguments were favourably listened to, and the poor *goiyas* and villagers of Ceylon have much reason to be proud of him who pleaded their cause so well, not only in Ceylon, but in England, and who, alas, has lived only to see the fulfilment of his wishes, and but little of the benefits which the welcome abolition is destined to bring

about. His one other pet scheme was that of flood outlet from the Kelani Valley.

Nothing short of a book could do justice to the many things the veteran colonist did for his adopted country, a brief newspaper article is incapable of embracing them, they were so many. Many we were thankful to say he saw fulfilled, others he would have seen had he lived. It was a life spent in the service of his country, and it might be truly said that he died practically in harness, still striving after that which would do good to his fellowmen.

As a public orator, Mr. Wall always commanded attention, and even to the end he was always ready and an interesting speaker. His last public appearance was in April last at a dinner given in honour of one of the proprietors of this journal, who was then about to depart for England, and to whom the news, on his arrival in the Island a few weeks ago, of the serious illness of his old friend and trusted ally came as a great shock. In February last he was present at the complimentary dinner given at Kandy to Sir (then Mr.) J. J. Grinlinton on his return from Chicago, when Mr. Wall replied to the toast of "The father and founder of the Planters' Association." As an after-dinner speaker he was always brimming over with humour.

It is not generally known that even in his straightened circumstances Mr. Wall was charitable to a degree. No deserving charity list was without his name, and the quiet way in which he dispensed other charities is only known by those who enjoyed the most intimate acquaintance with him.

Mr. Wall was a most enthusiastic bimetallist, and his frequent articles on the monetary question have been regarded as some of the most able that have appeared either here or in England. In politics he was conservative, but at the same time held very strong views on the advantages of free trade, and for his advocacy of the cause received the Gold Medal of the Cobden Club, a most exclusive honour.

Mr. Wall was a Fellow of the Royal Astronomical Society, Vice-President of the Ceylon Branch of the Royal Asiatic Society, and also a Fellow of the Linnean Society.

We have written but little about his literary abilities. Of them we cannot think without feeling the greatness of him we have lost. Still the public of Ceylon are the best judges, and they know as well as we the weight of that powerful pen, that marvellous intellect, that wonderful knowledge which made him such a giant amongst men. To us he was always the Grand Old Man, as such he will ever be remembered, and when we think of the brilliant mind that has passed from us, we cannot but remember those particularly applicable words :—

He was a man, take him for all in all,
We shall not look upon his like again.

. . . . . .

His life was gentle, and the elements,
So mix'd in him, that Nature might stand up
And say to all the world : "This was a man."

PREFACE.

In presenting this work to the public the author hopes to achieve more than one object. The volume was at first contemplated as a memorial to his father, the late George Wall. With this idea uppermost in his mind he has endeavoured to fill what he believes to be a long-felt want.

The book, it is hoped, will appeal specially to the field naturalist and student, and is written in as light a vein as possible consistent with a scientific work. The remarks on the identification of snakes and the keys and synopses to aid their recognition, he trusts, will be found simple and lucid enough to engage the attention of the naturalist, and enlist more workers in this admittedly difficult field of natural history research.

By collecting within one cover the scattered writings of previous authors and notes from various sources, it is further hoped that the volume may be found useful to the scientist already versed in ophiology.

It is not usual in a work of this nature to incorporate matters which are purely medical, but the author departs from this custom in the hope that the medical practitioner may find within these pages useful information concerning ophitoxæmia and its treatment.

Very little has been written about the snakes of Ceylon, and that little has been mostly descriptive and very incomplete. Kelaart, for instance, in his "Prodromus Faunæ Zeylanicæ" (1852), devotes four pages to the subject, and very briefly refers to four species. Gunther's work on the Reptiles of British India appeared in 1864, and included descriptions of many of the Ceylon snakes, with an occasional remark on habits, food, &c. Ferguson in 1877 published a pamphlet for private circulation, which is little more than a list of the snakes known up to that time to inhabit the Island. Haly published a list on very similar lines in 1886, and another in 1891. Boulenger's "Fauna of British India: Reptilia

and Batrachia," published in 1890, includes the Ceylon snakes, but is entirely descriptive. The same remark applies to the same author's "Catalogue of Snakes in the British Museum," which was completed in 1896. Since then Abercromby wrote a small treatise entitled "The Snakes of Ceylon" (1910), which is incomplete as a list, and very brief in its remarks. There are, however, many valuable observations about some of the species which I have made use of in the present work. Since "Spolia Zeylanica" appeared many have contributed notes to that Journal, which I have incorporated into my volume. Among those who have furnished the most valuable information, Mr. E. E. Green must be mentioned first. His notes have been excellent. Dr. Willey, Mr. Pearless, Mr. Abercromby, and others have written occasional notes to the same Journal, which have supplemented our knowledge of some of the species.

The reader of these pages will soon discover that our knowledge of many of the species referred to is fragmentary or even nil, and he will be in a position to know where he can furnish information that will enable a later author to compile a better and more comprehensive work. The present volume will justify its existence if this result alone is achieved.

There is still much to be known about the poisonous snakes of Ceylon, and it is hoped that the Government Medical Staff may contribute to our knowledge by reporting cases on the casualty form drawn up by me on page xxii.

No volume on the snakes of Ceylon can be considered complete without the inclusion of the marine forms. Situated as the Island is at the point of the peninsula of India, it is reasonable to expect that the sea snakes known from the Arabian Sea and the Bay of Bengal would be met with around its shores. Accordingly I have treated the subject on this supposition, and included all the sea snakes known from Indian coasts, from the Persian Gulf to Tenasserim. Many of the species referred to have not yet been actually recorded from the coasts of Ceylon, but I think it will be admitted, that there has not been up to date at all a thorough survey of the circumjacent waters.

A hilly country like Ceylon is to be regarded from the zoo-geographical point of view as an archipelago. Many snakes inhabiting upland regions have a very restricted habitat, neither ascending nor descending beyond certain limits. Many of the elevated ranges and peaks whose lower slopes merge into the low-country are just as effectually isolated as if they were surrounded by the sea, and thus form zoological islands. The field naturalist from this remark will see how important it is to attach a record of habitat and altitude to the specimens he collects. It would be natural to suppose that the denizens of the low-country are distributed throughout that area, seeing that there are no natural barriers to obstruct their wanderings. As far as is known, however, one snake, viz., the saw-scaled viper (*Echis carinatus*), occurs only in the northern part of the Island, and it is possible, when more records are available, that other species may similarly be found to be restricted in their habitat, dependent on rainfall, geological, and other conditions. From available records many of the hill species appear to be very local, apart from inhabiting a restricted belt of elevation. I think it extremely probable that many more hill snakes remain to be discovered in peaks and ranges that have up to now escaped special exploration. How little the Island has been explored is illustrated by my having discovered during my two months' visit to Ceylon two new species (viz., *Rhinophis drummond-hayi* and *R. porrectus*), a specimen of the Indian Krait (*Bungarus cæruleus*), only recorded three times before, and a specimen of the gamma tree snake (*Dipsadomorphus trigonatus*), the occurrence of which in Ceylon has been doubted, since the only mention of it is by Ferguson in 1877! I am extremely indebted to Mr. H. M. Drummond-Hay for placing his collection at my disposal and for much information. I had the pleasure of paying him a short visit, which proved to be quite an event in my life. I found his bungalow a veritable museum, stocked with specimens of every kind. He has devoted his attention more possibly to the snakes of Ceylon than to any other branch of Natural History, and I had the rare opportunity of examining many hundreds of specimens collected by him. Mr. Drummond-Hay is one of those rare

naturalists, who shuns rather than seeks the limelight, and consequently has never essayed to publish the results of his own observations. It has been my privilege to obtain first hand from him most valuable information regarding Ceylon snakes. In the matter of distribution especially, it is no exaggeration to say that his information surpasses that of all other records taken together. As this is an important matter, it is worth recording the field of his observations, which is as follows :—From January to May, 1897, Hapugastenne estate, Ratnapura District ; from May, 1897, to October, 1903, Hopewell estate, Balangoda district (3,000 to 4,200 feet) ; from October, 1903, to September, 1904, Punagalla estate, Yatiyantota district (below 3,000 feet) ; from September, 1904, to June, 1906, Warwick estate, New Galway district (5,000 to 6,000 feet) ; from June, 1906, to March, 1913, Galatura estate, Ratnapura District (500 to 1,000 feet) ; and from March, 1913, to March, 1920, Warwick estate, New Galway district (5,000 to 6,000 feet).

Mr. E. E. Green, who is so well known in Ceylon, deserves my gratitude for giving me valuable information that has never appeared in print, and for giving me some extremely valuable Ceylon specimens.

Lastly, I am much indebted to Dr. Joseph Pearson, for giving me access to the collection in the Colombo Museum, and to Mr. Gerard A. Joseph for giving me many valuable specimens.

The vernacular names given by natives to snakes in Ceylon are most unreliable, as they are in India, and it is most difficult to be certain what name is correct for even common species.

It will be noticed that I employ but one *i* in the termination of specific titles where many adopt a double *i*. My authority for so doing is Professor Edward Meyrick (Bombay Natural History Society's Journal, Vol. XX., p. 534), who wrote as follows : " As to the Latinizing of proper names, I think the position is as follows : The termination of a family name in Rome was *ius*, because the name was an adjective ; Cæsar's family name was *Julius*, because he belonged to the *Gens Julia*, the Julian family. A personal name, however, would be treated as a substantive, and made Latin by the simplest

practicable alteration, such as the addition of *us*, if no acknowledged Latin form already exists. Hence the family names Brown and Smith should be *Brownius* and *Smithius* ; but (and from the point of view of scientific species names this is the important fact) the genitives of names ending in *ius* should properly be written to end in *i* only, not in *ii* ; thus, the genitive of *Caius* is *Cai*, of *Smithius Smithi*, and as this is the case usually in question, the matter seems to be resolved thereby."

Finally, the author would gratefully welcome any observations or information any of his readers may be disposed to offer him, and especially specimens of the rarer species. Should the volume ever deserve a second edition, the information so acquired would be added with acknowledgments. The collector should realize that the value of any specimen is greatly enhanced by a record of its locality and date of capture. A piece of paper with these entries written in *ordinary lead pencil* should be attached to each specimen. Letters or specimens sent to the Honorary Secretary of the Bombay Natural History Society, 6 Apollo St., Bombay, would be forwarded.

GLOSSARY.

Aglyphous .. (Gr. "a" without, "glypho" I carve) implies without any fangs.

*Anisodont .. (Gr. "anisos" unequal, "odous" tooth.) Teeth of irregular length.

*Anododont .. (Gr. "a" without, "nodos" a toothless space, and "odous" tooth.) An uninterrupted series of teeth.

Canthus or Canthus rostralis .. (Gr. "kanthos" the corner of the eye.) A ridge from the eyebrow along the top of the snout.

Carinate .. (Lat. "carina" the keel of a ship.) A ridge along certain scales, like the midrib on the under side of a leaf.

Compressed .. (Lat. "compressus" pressed together.) Applied to the body when flattened laterally, as in the salmon.

†Coryphodont .. (Gr. "korypha" the summit, and "odous" tooth.) Increasing in length from before backwards.

Cranterian .. (Gr. "kranteres" the wisdom teeth.) Used to denote the teeth behind the gap when present at the back of the maxilla.

Cuneate .. (Lat. "cuneus" a wedge) wedge-shaped.

Depressed .. (Lat. "depressus" sunk down.) Applied to the body when flattened from above downwards, as in the crocodile or toad.

Diacranterian .. (Gr. "dia" apart, and "kranteres" the wisdom teeth.) Applied to teeth in the maxilla in which the last two or three are separated by a gap from the foregoing array. Not to be confused with oinododont.

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* In studying the teeth, I find there is a dearth of suitable terms to denote many variations of form and disposition. The writer, therefore, suggests many to which he attaches an asterisk.

† Originally applied by Owen to denote teeth with the cusps raised, as in certain extinct animals that lived in the Eocene period. Subsequently used by Dumeril and Bibron for teeth of snakes which increase in size from before backwards.

*Dinododont .. (Gr. "dis" double, "nodos" a toothless space, and "odous" teeth.) Applied to a set of teeth with two edentulous spaces.

Ectozoa .. (Gr. "ektos" outside, "zoon" animal.) Applied to parasites that infest the epidermis of animals.

Edentulous .. (Lat. "e" = without, "dens" tooth.) Applied to parts of the jaws without teeth.

Emarginate .. (Lat. "e" out of, "margo" the border.) Applied to a gap in the margin, such as a guard clips out of a ticket.

Entozoa .. (Gr. "entos" within, "zoon" animal.) Used for parasites that infest the internal cavities or organs of animals.

Exovation .. (Lat. "ex" out, "ovum" egg.) The act of hatching.

Hæmatozoa .. (Gr. "haima" blood, "zoon" animal.) Parasites that live in the blood.

Imbricate .. (Lat. "imbrex" a tile.) Overlapping like the tiles on a roof. It is to be noted, however, that the scales in snakes overlap in a contrary direction to tiles on a roof.

Isodont .. (Gr. "isos" equal, "odous" tooth.) Applied to teeth that are sub-equal in length.

Isomorphous .. (Gr. "isos" equal, "morphe" form.) Similar in shape.

Juxtaposed .. (Lat. "Juxta" by the side of, "pono" I place.) Side by side like the tiles on a floor.

*Kumatodont .. (Gr. "kuma" wave, "odous" tooth.) A set of teeth reducing in length anteriorly and posteriorly.

Lepidosis .. (Gr. "lepis" scale.) The shield and scale vesture of a snake.

Mandible .. The lower jaw.

Maxilla .. The upper jaw.

Nuchal .. (Gr. "nucha" nape.) The back of the neck.

*Oinododont .. (Gr. "oinos" one, "nodos" a toothless space, "odous" tooth.) With a single gap anywhere in the dental array, except behind. (See diacranterian.)

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* In studying the teeth, I find there is a dearth of suitable terms to denote many variations of form and disposition. The writer, therefore, suggests many to which he attaches an asterisk.

Opisthoglyphous .. (Gr. "opisthe" behind, "glypho" I carve.) Applied to the maxilla that bears fangs posteriorly.

Palatine .. The tooth-bearing bone at the front of the roof of the mouth.

Proteroglyphous .. (Gr. "proteros" in front, "glypho" I carve.) Applied to the maxilla with fangs anteriorly.

Pterygoid .. The tooth-bearing bone behind the palatine.

Rectiform .. (Lat. "rectus" straight, "forma" shape.) Applied to scales that are not oblique.

*Scaphiodont .. (Gr. "skaphe" a boat, "odous" tooth.) Decreasing in length from before backwards. This type of dentition when seen in the lower jaw reminds one of the shape of the bows of a ship.

Serrate .. (Latin "serra" a saw.) Toothed like a saw.

Syncranterian .. (Gr. "syn" together, "kranteres" the wisdom teeth.) Applied to teeth that have no toothless gap near the back of the maxilla. (As opposed to diacranterian.)

Syndrome .. (Gr. "syn" together, "dromos" a running. A combination of characters. Usually applied medically, but may be conveniently used zoologically.

Tylotose .. (Gr. "tulotos" knobbed.) With a boss or swelling.

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* In studying the teeth, I find there is a dearth of suitable terms to denote many variations of form and disposition. The writer, therefore, suggests many to which he attaches an asterisk.

EXPLANATION OF THE ABBREVIATIONS FOR LEPIDOSIS USED IN THE FIGURES.

An.	Anal.
A. S.	Anterior sublinguals.
Cos.	Costals.
C. S.	Caudal shield.
Cun.	Cuneate.
F.	Frontal.
I. or Int.	Internasals.
Ipl.	Interparietal.
Lor.	Loreal.
M.	Mental.
N.	Nasals.
Oc.	Ocular.
Pa.	Parietals.
Po.	Postoculars.
Pop.	Postparietal.
Pr.	Præoculars.
Prf.	Præfrontal.
Prp.	Præparietal.
P. S.	Posterior sublinguals.
R.	Rostral.
S.	Supraocular.
Sl.	Supraloreal.
Spc.	Supracaudals.
Su.	Subocular.
Sub.	Subcaudals.
T.	Temporals.
Ult.	Ultimate costals.
Ven.	Ventrals.
Ver.	Vertebrals.
Arabic numerals.	Supralabials.
Roman numerals.	Infralabials.

CASUALTY RETURN OF SNAKE-BITE.

Station :———.
Sex :———.
Age :———.
Date and hour of bite :———.
Hour of admission :———.
Part bitten :———.
Species of snake :———.
Result :———. If fatal, method of death, syncope or asphyxia :———. Time elapsed since bite :———.

Symptoms : Local :—

(*a*) Pain :———.
(*b*) Swelling :———.
(*c*) Sanious oozing :———.
(*d*) Appearance of tissues when cut into:———.
(*e*) Characters due to mechacal causes :———.

General :—

(*a*) Consciousness :———.
(*b*) Respiration :———.
(*c*) Syncope, pallor :———.
Warmth and activity of skin :———.
Pulse :———.
Vomiting :———.
Onset of weakness :———.
(*d*) Paralysis, onset of weakness :———.
Sequence :———.
Drooping head :———.
Drooping eyelids :———.
Articulation :———.
Phonation :———.
Deglutition :———.
Salivation :———.
(*e*) Hæmorrhages :———.
(*f*) Other symptoms :———.
Treatment :———.

SNAKES OF CEYLON.

ERRATA.

With the exception of the sub-family *Hydrophiinæ*, which I have revised, I have adopted in this work the nomenclature used in Boulenger's Catalogue, 1893 to 1896. Since this book was written I have been engaged writing a hand list of the Indian snakes, and I find that in some cases the generic and specific names used by Boulenger do not appear to be valid. The following corrections are, therefore, called for :—

Page 89 : *For* "TROPIDONOTUS" *read* "NATRIX."

Page 102 : *For* "AMPHIESMA" *read* "RHABDOPHIS."

Page 146 : *For* "LYCODON" *read* "OPHITES."

Page 171 : *For* "ZAOCYS" *read* "PTYAS."

Page 233 : *For* "O. subgriseus" *read* "O. tæniolatus."

Page 250 : *For* "ABLABES," *read* "LIOPELTIS."

Page 255 : *For* "CERBERUS" *read* "HURRIA."

Page 285 : *For* "DIPSADOMORPHUS" *read* "BOIGA."

Page 344 : *For* "ATURIA" *read* "MICROMASTOPHIS Gen. Nov."

Page 368 : *For* "CHITULIA" *read* "ATURIA."

Page 390 : *For* "PRÆSCUTATA" *read* "THALASSOPHIS."

will soon discover how important the shielding of the head is in identification.

The first thing to do is to lay the specimen on its back and search for the opening of the cloaca, a transverse slit in the posterior part of its length. This demarcates the end of the body and the commencement of the tail. The body and tail should then be measured and noted. The shields on the belly (ventrals) should then be counted and

CASUALTY RETURN OF SNAKE-BITE.

SNAKES OF CEYLON.

THE IDENTIFICATION OF A SNAKE.

ASSUMING a snake to be dead, its identification is in most cases an easy matter. The inquirer, however, must be prepared to handle his specimen and critically examine it. His powers of observation must be directed to various features upon which the classification of snakes is based, most of which concern the scales and shields which cover the various regions of the specimen. The word "shield" is used to denote the large plate-like epidermal divisions one sees on the heads of colubrines and on the underparts of most snakes, "scale" being reserved for the small divisions such as one sees on the upper part of the body and tail. In order to study these properly the student must equip himself with a high-power watchmaker's lens and a pair of fine pointed compasses. The watchmaker's lens is recommended because it permits the use of both hands during the manipulation of the specimen, and it must be remembered that during use *both* eyes are kept open, if the lens is to be easily retained in the eye. The compasses are necessary, because all measurements referred to have been arrived at by their use, and because the relative breadths and lengths of shields without measurement are often very deceptive. The collector should try to secure his specimens without damaging the lepidosis of the head, for he will soon discover how important the shielding of the head is in identification.

The first thing to do is to lay the specimen on its back and search for the opening of the cloaca, a transverse slit in the posterior part of its length. This demarcates the end of the body and the commencement of the tail. The body and tail should then be measured and noted. The shields on the belly (ventrals) should then be counted and

their breadth noted, the shield before the anus (anal) examined to see if it is entire or divided, and the shields beneath the tail (subcaudals) examined to see if they are entire or divided and then counted. It is best to begin at the tip and count to the anus, so that the smallest shields are dealt with while the eye is fresh to the work, instead of when strained and tired. The necessity of the lens to the observer will at once become apparent. All these things noted, attention should then pass to the scales over the back (the costals or simply "scales"). These should be counted from one side of the ventrals to the other in three situations, viz., two heads-lengths behind the head, midbody, and two heads-lengths before the vent; their relative breadth and length noted; and whether the vertebral or median row is enlarged or not; and any other details. After this the head shields should be studied, each in detail, and noted. These and other details will readily be grasped by reference to the various figures which follow, the scales and shields in which are all lettered.

It is advisable first of all to place your specimen in the family to which it belongs, and this can be done by studying the keys below.

It must be borne in mind that the keys are based on the characters of normal specimens. Many individuals, however, show some aberration or other. This fact, the variation of individuals, indeed is one of the essential bases upon which the Darwinian doctrine of evolution rests.

KEY TO FAMILIES.

For Indian Species.

TAIL ROUND IN SECTION. Families.

(A) Ventrals not enlarged (see fig. 3).
Anal divided into 3 or 4 (see fig. 3).
Costals broader than long (see fig. 3).
Eye beneath shields. Pupil round (see fig. 2).
(*a*) Costals in 16 to 36 rows at midbody Typhlopidæ
(*b*) Costals in 14 rows at midbody .. * Glauconiidæ

* Not represented in Ceylon.

TAIL ROUND IN SECTION.	Families.
(B) Ventrals enlarged, but not twice last costal row (see fig. 11). Anal divided into two; twice breadth of ventrals (see fig. 11).	
Costals broader than long.	
(*a*) Supralabials four ..	.. Uropeltidæ
(*b*) Supralabials six ..	.. Ilysiidæ
(C) Ventrals 2 to 2½ times breadth of last costal row (see fig. 17). Anal as broad as ventrals (see fig. 17).	
Costals broader than long. Eye mobile, surrounded by many shields.	
Pupil vertical.	
(*a*) Costals in 15 rows at midbody	..*Xenopeltidæ
(*b*) Costals more than 40 rows at midbody ..	.. Boidæ
(D) Ventrals more than three times as broad as last costal row. Anal as broad as ventrals. Costals as long or longer than broad. Eye mobile, surrounded by many shields.	
(*a*) No mental groove. Three pairs of large asymmetrical sublinguals.	
Pupil vertical ..	..*Amblycephalidæ
(*b*) A mental groove. Two pairs of sublinguals (see fig. 20). Pupil variable (except *Chersydrus*†)	.. Colubridæ (except Hydrophiinæ)
(*c*) A mental groove. One pair of sublinguals (see fig. 91). Pupil variable	Viperidæ
TAIL COMPRESSED INTO A FIN	.. Sub-family Hydrophiinæ of Colubridæ

For Ceylon Species.

Ventrals not enlarged	.. Typhlopidæ
Ventrals enlarged:—	
Last costal row ⅔ breadth of ventrals. Anal twice or nearly twice breadth of ventrals:—	
Eye in a single shield	.. Uropeltidæ
Eye surrounded by shields	.. Ilysiidæ
Last costal row ½ breadth of ventrals. Anal as broad as ventrals ..	.. Boidæ
Last costal row one-third or less the breadth of the ventrals. Anal as broad as ventrals:—	
Two pairs of sublinguals	.. Colubridæ
One pair of sublinguals	.. Viperidæ

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* Not represented in Ceylon.

† *Chersydrus* has no ventral shields developed, its costals broader than long, no mental groove, and no sublinguals.

Family **TYPHLOPIDÆ.**

(Named from the type Genus *Typhlops.*)

General Characters.—This family includes the most diminutive of ophidian forms, many of which in their adult form attain to only 150 mm. (6 inches) or less. It includes also the most degenerate forms. Head broad, and evenly rounded; snout short without a canthus, terminating in a broadly rounded, or rarely in a beaked extremity. Eyes situated beneath one or more shields, small, purblind. Nostril lateral or inferior, and small. Mouth small, and situated beneath the snout. Neck not evident. Body slender, or robust; short, moderate, or elongate; cylindrical, and of even calibre throughout. Its scales are highly polished, and thus do not favour the adhesion of soil to their surface. Belly rounded. Tail very short, conical, and in many ending in a small, acute spine directed downwards, and backwards.

Identification.—Known by the costals being broader than long, the ventrals which are not enlarged, and the presence of four supralabial shields.

Habits.—Subterrestrial. They burrow nimbly. Locomotion above ground is good, but on a smooth surface little or no progress is made, despite much muscular effort. They are extremely defenceless creatures, that only escape annihilation from a host of rapacious foes by having adapted themselves to a subterranean existence. As far as is known all are oviparous.

Food.—The larvæ, pupæ, and imagines of ants, and similar insects.

Poison.—They are not poisonous.

Lepidosis.—The head is covered with large shields, of a type and character peculiar to this family.

Costals.—Broader than long, broadly rounded posteriorly; rectiform, smooth, and highly polished. In from 16 to 36 rows. *Ventrals:* Not enlarged, and therefore usually counted with the costals, thereby making the rows an even number. *Anal:* Absent, replaced by three or four scales. *Subcaudals:* Not different from the supracaudals.

Dentition.—*Maxillary :* Transverse ; number of teeth 4 or 5 ; markedly scaphiodont. *Palatine :* edentulous. *Pterygoid :* edentulous. *Mandibular :* edentulous.

Distribution.—South Europe; South Asia ; Africa; Australia ; Tropical America.

The family includes three genera. Only one of these is represented in India, including Ceylon, viz., *Typhlops.*

Genus TYPHLOPS.

(Greek " tuphlos " blind, " ops " eye.)

General Characters.—Diminutive snakes, with few exceptions exceeding 8 or 9 inches in length. Head rounded, in a few species beaked ; about as broad as the body. Eyes distinct or indistinct, lying beneath shields, which thus protect them from injury when the snake is burrowing. Nostrils lateral or inferior, slit-like. Body cylindrical ; short or elongate ; of even calibre throughout ; covered with highly polished scales, the purpose of which appears to be to prevent becoming clogged with the earth into which they burrow. Tail very short, with or without a terminal spine.

Habits.—The species live for the most part beneath the surface soil. The snout is used in burrowing, and during this operation the little spine at the end of the tail is pushed into the ground, and serves as a sort of fulcrum. The snout being in most species broadly rounded does not appear to be well adapted for burrowing, and unless the soil is loose this cannot be accomplished. The species whose snouts end in a beak do not appear to me to be any better equipped for burrowing, judging from results.

Some of the species have been observed to exhibit a gregarious habit, and have been found in colonies in decaying wood. A rotting log offers great attraction on account of the beetle and other insect larvæ and pupæ developing therein. It may, too, prove additionally attractive from the warmth generated by the process of decay. Such an environment may

also serve the purpose of bringing the sexes together for matrimonial relationship. Vision is more or less obtuse at the best, but becomes more and more obscured as a period of desquamation approaches, from scratches sustained during burrowing operations.

They are extremely defenceless reptiles. The mouth lies beneath the snout, and could not inflict an injury to any but the smallest creatures, apart from the fact that there are no opposable teeth with which to bite.

Food.—They live on worms, grubs, and insects in the various stages of their metamorphoses.

Breeding.—As far as is known they are oviparous. In the case of the Burmese species *diardi*, I ascertained that very minute embryos are in process of development before the eggs are discharged.

Poison.—All are non-poisonous.

Lepidosis.—The head is covered with large shields, having a form and disposition peculiar to the genus.

The scales on the body are very highly polished, and this appears to be a special adaptation to prevent the adhesion of earth to them. Owing to this polish it is very difficult to see the outlines of the scales unless viewed in reflected light. The scales, too, have a dark, subterminal zone, which seems to indicate their borders, but which in reality does not. The diminutive size of the creatures, combined with these two other conditions, make it extremely difficult, without practice, to count the scales, or to see the characters for which one is specially looking.

Distribution.—South Europe ; South Asia ; Africa ; Tropical America ; Australia.

Mr. Drummond-Hay tells me that he has never had any single *Typhlops* brought in to him. His coolies bring in the cæcilian *Icthyophis glutinosus* frequently, and also elongate lizards, such as some *Lygosomata*, and even worms. From this it would appear that the Ceylon *Typhlops* are exclusively low-country snakes.

About one hundred species are known, of which about eighteen are Indian and three occur in Ceylon, viz., *mirus*, *braminus*, and *leucomelas*.

Synopsis of chief characters in the Lepidosis of species of *Typhlops*.

	mirus.	braminus.	leucomelas
Snout rounded	Yes	Yes	Yes
Breadth of rostral to head	½	⅓	⅓
Nasals :—			
Suture above nostril complete	Yes	Yes	Yes
Suture below nostril to	2nd lab	Præoc	2nd lab
Meeting behind rostral	Yes	No	No
Labials :—			
Touching præocular	None	2nd & 3rd	2nd & 3rd
Touching ocular	4th	3rd & 4th	3rd & 4th
Subocular	One	None	None
Temporals	2	1	2 or 3
Costal rows	18	20	22
Caudal spine	No	Yes	Yes

TYPHLOPS MIRUS Jan.

(Latin " mirus " wonderful, possibly on account of its diminutiveness.)

Jan's Ceylon Typhlops (or Blind Snake).

Synonymy.—Nil.

History.—Described by Jan in 1860.

General Characters.—Only about five inches long in its adult state. Head of the same calibre as the body. Snout rounded. Eyes indistinct or invisible. Nostrils antero-lateral. Body rather elongate, its diameter being about 1/37 to 1/60 the total length. Tail conical with no spine.

Identification (for Ceylon).—The costals in 18 rows will indicate the species.

Colouration.—Brown dorsally, snout and lower parts yellowish.

Habits and Breeding.—Nothing known.

Growth.—*Maximum length :* Up to 140 mm. (5½ inches).

Lepidosis.—*Rostral :* About half the breadth of the head. *Præfrontal, frontal,* and *interparietal :* Subequal; rather broader than the dorsal scales. *Supraocular, præparietal,* and *postparietal :* Subequal ; rather broader than the dorsal scales. *Supraoculars* and *præparietals :* Subequal ; rather broader than the dorsal scales. *Postparietal :* Usually subequal to the præparietal, sometimes broken up into two. *Nasals :* Sometimes in contact behind the rostral ; usually not ; quite

divided; the upper suture from the nostril about half the lower which passes to the 2nd supralabial. *Præocular:* Well developed; widely separated from the 2nd supralabial. *Ocular:* Well developed. *Subocular:* Present; touching the 2nd, 3rd, and 4th supralabials. *Temporals:* Two. *Supralabials:* Four.

Costals: In 18 rows in the whole body.

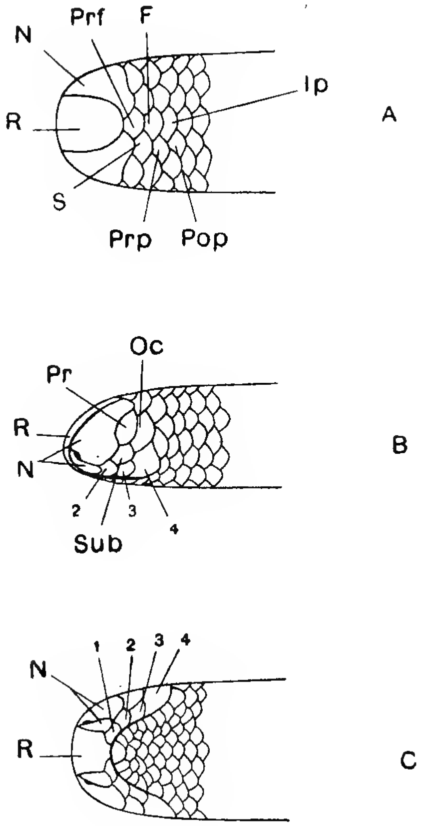

FIG. 1.—Typhlops mirus.
(After Gunther.)

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Haly has recorded it from Colombo, and in the Indian Museum there are three from Peradeniya. Apparently an uncommon snake. I have examined five specimens.

TYPHLOPS BRAMINUS (Daudin).

(Latinized form of Brahmin, in allusion to its brown colouration.)

Russell's Typhlops (or Blind Snake).

Sinhalese : " Depat-naya " (two-headed snake), *Tamil :* " Manallay pambu " (earth snake) ; " sevi pambu " * (ear snake) ; " pooran " * (centipede).

Synonymy.—*Eryx braminus, Tortrix russellii, Argyrophis truncatus, A. bramicus, Onychocephalus capensis, Ophthalmidium tenue, Typhlops inconspicuus, T. tenuis, T. pammeces, T. reuteri, T. lenzi, T. euproctus.*

History.—First introduced to scientific notice by Russell in 1796. It is figured on Plate XLIII. of his first volume.

General Characters.—It is less than 7 inches long in its adult state. Head of the same calibre as the body ; snout rounded. Eye distinct, lying beneath the ocular and supraocular shields. Nostrils lateral. Body moderately elongate ; its diameter 1/35 to 1/55 the total length. Tail ending in a spine.

Identification (for Ceylon).—The costals in 20 rows will suffice to identify it.

Colouration.—Three varieties have been described.

(*a*) *typicus* (Daudin).—Brown or blackish-brown dorsally, rather lighter ventrally. Snout, anal region, and end of tail whitish. Much the commonest variety.

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* According to Dr. J. R. Henderson these two names are used by the Tamils of Madras. Both names are applied to it under the supposition that they enter the human ear, like the centipede is supposed to do.

(*b*) *arenicola* (Annandale).—In this each scale on the back is faintly tinged with buff, those on the head being faintly vermiculated with the same hue. In life it is a pale flesh colour. Belly white. Dr. Annandale met with this in South India.

(*c*) I have met with specimens of a uniform pale gray hue, and with the eyes invisible. This may be due to impending desquamation, and in that case does not deserve recognition as a variety. I acquired specimens from Assam.

Habits.—The common blind snake is not often seen by Europeans, or if seen is not recognized as a snake, its size and general appearance allowing it to pass for an earthworm. It spends most of its life beneath the surface soil, through which it burrows nimbly, and is often brought to light by the cooly's hoe, or the ryot's plough. It is likely to be met with by the amateur gardener in and about his pots, in the heap of leaf mould, or in the soil freshly turned over by the trowel. It not infrequently secretes itself beneath stones or débris. After heavy rains it is not infrequently seen on the ground by those who can recognize it, after being swamped out of its subterranean burrows. On such occasions it is met with singly, but it has been occasionally discovered in large colonies inhabiting rotten wood.

It is an active little creature, making vigorous attempts to escape if dislodged from its hiding place. When handled it shows its resentment by vehement struggles, and is most difficult to hold owing to the high polish of its scales. When its struggles have quieted down, it presses the little spine with which its tail is endowed into the hand, anchoring itself as it were, and from the purchase so derived wriggles about restlessly in all directions, pushing its nose about, and insinuating itself forcibly between the clefts of one's fingers. Above ground, its progress is smooth and active, and in water it swims well. Under excitement it protrudes the tongue like other snakes.

This is almost certainly the species which some years ago invaded the water supply in Calcutta, many specimens finding their way into the pipes of distribution. Much surprise and

consternation were evinced by timid residents when a living specimen appeared through the tap supply. It sometimes invades houses in considerable numbers from the garden or pot plants. Captain Stevenson, I.M.S., told me that in Manipur it is extremely common in houses. He has found three in a single evening wriggling about the floor when he was dressing for dinner, and one subaltern in his regiment collected about one hundred in his house in about a month.

Food.—Most of those that I have dissected have had full stomachs, and the contents when investigated proved to be the larvæ, pupæ, and imagines of ants, and probably beetles, and other insects. Dr. Annandale discovered one in the burrow eaten by a caterpillar in a stalk of sugar cane. The caterpillar had vacated or, perhaps, had been eaten by the snake, and subsequently in captivity the snake was observed to eat the caterpillar droppings.

Foes.—It is very frequently preyed upon by young kraits (*B. cæruleus*). I have recovered many in this manner. Fowls and other birds will readily eat them.

Breeding.—The brahminy snake is believed to be oviparous, but I am not aware of any certain evidence in this direction. All the gravid females I have known were in Assam, and these, eight in number, were collected in the hot weather from April to July. In length they ranged between 152 to 162 mm. (6 inches and 6⅜ inches). Six of these were brought to me on the same day by the same boy, who had evidently unearthed a colony, and only one male was brought with them. The eggs, which whilst in the abdomen resemble grains of cooked rice, varied from 2 to 7 in number, the largest measuring 13 mm. by 4 mm. (18/32 by 5/32 of an inch).

Growth : (*a*) *Maturity.*—My smallest gravid female was 152 mm. (6 inches).

(*b*) *Maximum Length.*—It grows to about 150 to 170 mm. (6 to 6⅞ inches).

Parasites : *Entozoa.*—The nematode worm *Kallicephalus willeyi* has been found infesting the stomach by Von Linstow.

Lepidosis.—*Rostral :* About one-third the breadth of the head opposite the eyes, not reaching as far back as the eyes.

Præfrontal, *frontal*, and *interparietals :* Subequal. *Supra-oculars*, *præparietals*, and *postparietals :* Subequal, or the last broadest. *Nasals :* Not in contact behind the rostral; quite divided; the suture above the nostril much longer than that below; the suture below the nostril extending to the præocular. *Præoculars* and *oculars :* Subequal. *Suboculars :* Absent. *Temporals :* One. *Supralabials :* Four; 2nd and 3rd touching the præocular, 3rd and 4th touching the ocular. (Fig. 2.)

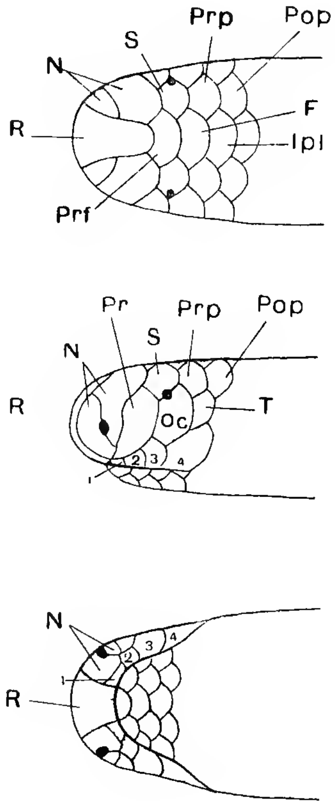

FIG. 2.—Typhlops braminus.

(× circa 6 diametres.)

Costals: In 20 rows in the whole body. *Anal:* Not differentiated. (Fig. 3.)

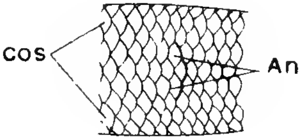

FIG. 3.—Anal region of Typhlops braminus.
(× 5.)

Dentition.—The head is too diminutive to favour the preparation of a skull.

Distribution: (*a*) *General.*—South Asia; Islands of the Indian Ocean, *i.e.*, Ceylon, Cocos, Andamans, Mauritius, Madagascar, Comoros; Africa south of the Equator.

(*b*) *Local.*—It is a denizen of the low-country, but ascends to an elevation of at least 3,000 feet.

It is very abundant in India and Ceylon.

TYPHLOPS LEUCOMELAS Boulenger.

(Greek " leukos " white, and " melas " black, implying pied.)

The Pied Typhlops (or Blind Snake).

Synonymy.—Nil.

History.—Described by Boulenger in 1890.

General Characters.—Less than 6 inches long in its adult state. Head of the same calibre as the body, snout rounded. Eyes distinct; lying beneath the ocular shield. Nostrils lateral. Body short, its diametre being 1/23 to 1/32 the total length. Tail ending in a spine directed backwards and downwards.

Identification (for Ceylon).—The costals in 22 rows will suffice to indicate the species.

Colouration.—Blackish-brown dorsally, pure white ventrally (Boulenger). The one in the Colombo Museum is light brown dorsally, paler brown beneath.

Habits and Breeding.—Nothing known.

Growth.—*Maximum Length :* 130 mm. (5⅛ inches).

Lepidosis.—*Rostral :* About one-third the breadth of the head opposite the eyes; extending as far back as the eyes. *Præfrontal, frontal*, and *interparietal :* Progressively decreasing in breadth. *Supraoculars* and *præparietals :* Subequal. *Post-parietals :* Two; small. *Nasals* · Not in contact behind the rostral; quite divided; the upper suture more than twice the lower; the lower suture passing to the 2nd supralabial. *Præoculars* and *oculars :* Subequal. *Suboculars :* Absent. *Temporals :* Two. *Supralabials :* Four; 2nd and 3rd touching the præocular, 3rd and 4th touching the ocular. (Fig. 4.)

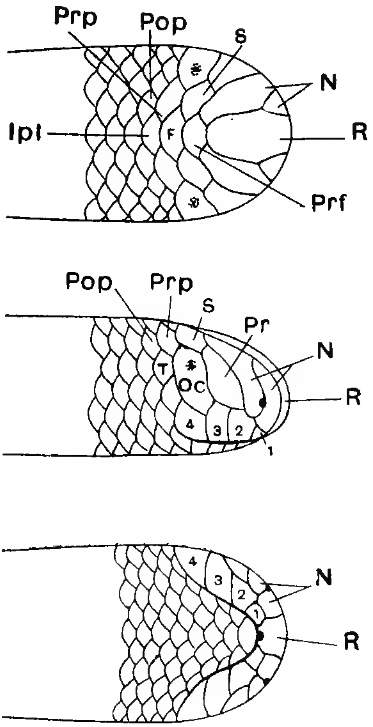

FIG. 4.—Typhlops leucomelas. (After Boulenger.)
(× circa 6 diametres.)

Costals: In 22 rows in the whole length. *Anal:* Not differentiated.

Distribution.—(*a*) *General:* Only known from Ceylon.

(*b*) *Local:* Apparently very rare. Until recently only one specimen was known, which was acquired by Colonel Beddome on Haycock mountain, near Galle, at 2,000 feet elevation. I found one in the Colombo Museum without history measuring 626 mm. ($2\frac{5}{8}$ inches).

Family **GLAUCONIIDÆ.**

Not represented in Ceylon.

Family **ILYSIIDÆ.**

(Named after the type Genus *Ilysia.*)

General Characters.—Small snakes not exceeding about $2\frac{1}{2}$ feet in length. Head moderately depressed, as broad as body, cuneate in profile. Snout longish, without canthus, broadly rounded anteriorly. Eye small with round or vertically elliptic pupil; in a single shield, or surrounded by many shields. Nostril small in a single shield. Chin with or without a mental groove. Neck not constricted. Body cylindrical, stout, of even calibre throughout. Belly rounded. Tail very short, conical. Vestiges of a hind limb, which are visible as small claw-like appendages on each side of the vent.

Identification.—Last costal row about two-thirds the breadth of the ventrals. Anal nearly twice the breadth of the ventrals.

Habits.—Subterrestrial, burrowing nimbly; movements above the soil laboured. Dull and lethargic. Diurnal.

Food.—Eels and snakes (Malcolm-Smith).

Breeding.—Viviparous as far as known.

Poison.—Non-poisonous.

Lepidosis.—*Rostral:* Touches four shields. *Nasals:* In contact behind rostral. *Internasals:* Absent. *Præfrontals:* Two. *Frontal:* Present. *Supraoculars:* Present. *Parietals:* Present or absent. *Loreal:* Absent. *Præoculars:* Absent. *Postoculars:* Present or absent. *Temporals:* Present.

Supralabials : Four to six; one or two touching the eye except in *Ilysia*. *Sublinguals :* Two pairs. *Infralabials :* Three; none touching the posterior sublinguals.

Costals : In midbody. Broader than long, broadly rounded posteriorly, rectiform, smooth. The vertebral row smallest, about two-thirds the breadth of the ultimate. Ultimate and one or two rows above progressively decreasing in breadth. Ultimate. Breadth of scales one and a half times their length, and two-thirds that of the ventrals. In 19 to 21 rows at midbody. *Ventrals :* Enlarged but narrow. *Anal :* Entire or divided; nearly twice the breadth of the ventrals in *Cylindrophis*. *Subcaudals :* Entire or divided, less than 15.

Dentition.—*Præmaxillary :* Teeth present in *Ilysia*, absent in others. *Maxillary :* 9 to 12; slightly kumatodont. *Palatine :* 6 or 7; isodont. *Pterygoid*. 6 to 9; scaphiodont. *Mandibular :* 9 to 12; slightly kumatodont.

Distribution.—South Asia; Tropical South America. The family comprises three genera: *Ilysia*, peculiar to South America; *Anomalochilus*, peculiar to Sumatra; and *Cylindrophis*, known from Ceylon, Indo-China, and Malaysia.

Genus CYLINDROPHIS.

(Greek "kulindros" a cylinder, "ophis" snake.)

General Characters.—Small snakes growing to about 2½ feet. Head broad and depressed. Snout moderately long, broadly rounded, without canthus. Eye very small, with vertically elliptic pupil. Nostril small, situated on the outer side of the nasal shield. Chin with a mental groove. Body cylindrical, moderately elongate, stout. Belly rounded. Tail very short and conical, ending in a subacute point.

Identification.—Costals in 19 or 21 rows at midbody, ventrals less than twice the breadth of the last costal row, and the eye surrounded by five shields, taken together will establish the Genus in Ceylon.

Habits.—Very little is known of their habits, except that they burrow and live mainly beneath the soil. Flower makes remarks on *C. rufus*, the species found in Burma, Indo-China, and the Malayan Peninsula and Archipelago, which might

apply to the Ceylon species if looked for : " At ordinary times this snake is fairly cylindrical in section, and uses its tail in progression, putting the sharp tip against the ground, and pushing its body forward from it ; but it has the power of depressing the body, when its appearance is very singular ; the neck and anterior part of the body are but slightly compressed, but posteriorly it is very much so. Consequently, when seen from above the outline of the snake is much that of a seasnake seen from the side. When touched or worried it will not attempt to strike or bite, but keeps its head flat on the ground, usually hidden under the folds of the body ; its tail, however, it raises off the ground, and holds aloft curved over backwards in the most extraordinary manner, so that any casual observer would imagine the tail was the head, and think the snake to be threatening to strike. Sometimes the tail, is not curved over, but held in the manner most snakes hold their heads when advancing."

Food.—Dr. Malcolm-Smith, speaking of the Burmese and Indo-China species *rufus*, says it feeds on eels, and other snakes, " its appetite is gargantuan. It seems to prefer a meal at least as large as itself, if not larger, and the manner in which it can pack its food away and appear but little bigger afterwards is extraordinary. One I had in captivity, itself 400 mm. in length, overcame, and devoured a keel back (*Tropidonotus piscator*) of 500 mm. (20 inches), the latter snake being well known for its activity and aggressiveness. Another was found having just swallowed a water-snake (*Homalopsis buccata*), the former 780 mm. long and the latter 925 mm. Two other specimens were caught in the water in the act of swallowing eels, their prey on each occasion being several inches longer than themselves."

I am not aware of any special observations with regard to the diet of *maculatus*, nor are there any records showing that it haunts marshy land.

Breeding.—The Ceylon species *maculatus* is viviparous.

Lepidosis.—*Rostral :* Touches four shields. *Nasals :* In contact behind the rostral. *Internasals :* Absent. *Præfrontals :* A pair. *Frontal :* Subequal to the supraoculars in length and breadth. *Parietals :* As long as or longer than the frontal.

Loreal : Absent. *Præoculars :* Absent. *Postoculars :* One. *Temporals :* One. *Supralabials :* Six ; the 3rd and 4th touching the eye. *Sublinguals :* Two pairs. *Infralabials :* Three.

Costals : Broader than long ; broadly-rounded posteriorly ; rectiform ; smooth. Vertebrals not enlarged. Last four rows subequal and broader than the rest. Ultimate row about four-fifths the breadth of the ventrals. In 19 or 21 rows at midbody. *Ventrals :* Feebly enlarged. *Anal :* Divided ; one and a half times the breadth of the ventrals. *Subcaudals :* Divided or some entire ; numbering from 4 to 10.

Dentition.—*Maxillary :* Anododont, feebly kumatodont. *Palatine :* Anododont, feebly kumatodont. *Pterygoid :* Anododont, scaphiodont. *Mandibular :* Anododont, kumatodont.

Distribution.—Ceylon, Burma, Indo-China, Malay Peninsula, and Archipelago to Celebes. There are three species only, one of which occurs in Ceylon, viz., *maculatus.*

Cylindrophis maculatus (Linné).

(Latin " maculatus " spotted.)

Linné's Cylindrophis (*or Earth Snake*).

Singhalese : " Depat-naya " (two-headed snake).

Synonymy.—*Anguis maculata, A. decussata, Tortrix maculatus, Ilysia maculata.*

History.—Described and christened by Carl Linné as far back as 1754.

General Characters.—A small snake growing to about 2½ feet. Head broad, but not so broad as the body, depressed ; wedge-shaped seen in profile. Snout moderate in length, broadly rounded terminally ; without canthus. Eye very small with a vertically elliptic pupil. Nostril small, round, directed upwards; situated on the outer side of the nasal shield. Chin with a mental groove. Neck stout, not constricted. Body very stout ; cylindrical ; moderately elongate. Belly rounded. Tail very short, conical, ending in a subacute point.

Habits.—(*a*) *Haunts :* A burrowing snake that lives beneath the soil.

(*b*) *Disposition :* A very placid snake that exhibits no sign of temper. Haly says : "Placed on a table it makes no attempt to escape, but lies with its head beneath its lowest coil, and its tail spread out so as to resemble the head of a cobra, which it imitates in its motions. If irritated for some time it finally ejects from the anus a few drops of a yellow acrid liquid." I think the secretion alluded to is from the anal glands which open on each side of the roof of the cloaca.

(*c*) *Progression :* Above the soil its progression is hampered, and slow.

Food.—I know of no observations in this direction.

Breeding.—(*a*) *Method of Reproduction :* Abercromby was the first to show that it is viviparous in habit, and I am in a position to confirm this observation.

(*b*) *Season :* Abercromby's gravid specimen was captured on April 1.

(*c*) *Period of Gestation :* Not known.

Growth.—(*a*) *The Young :* The young are retained until they attain a very unusual degree of development. In a gravid specimen of mine, I found two fœtuses measuring 127 to 137 mm. (5 and $5\frac{3}{8}$ inches). The former was a male, and the latter a female. Abercromby's gravid female contained three embryos. A recently born specimen measured 127 mm. (6 inches).

(*b*) *Maturity :* My dam just alluded to measure 272 mm. ($10\frac{3}{4}$ inches). If this species grows as rapidly as other snakes, and doubles its length in the first year of life, this specimen must have been only one year old.

(*c*) *Maximum Length :* My largest specimen was 622 mm. (2 feet and $\frac{1}{2}$ an inch) in length.

Lepidosis.—*Rostral :* Touches four shields ; projected backwards to separate half the length of the nasals. *Nasals :* In contact behind the rostral. *Præfrontals :* As long as the frontal ; touching the nasals, 2nd and 3rd supraoculars, eye, and supraocular. *Frontal :* Touches six shields ; the fronto-supraocular sutures about twice the length of the fronto-parietals. *Supraoculars :* As long as the frontal but reaching

further back, as broad as the frontal along a line connecting the centres of the eyes. *Parietals :* Longer than the frontal. *Præocular :* None. *Postocular :* One. *Temporal :* One ; nearly as long as the supraocular. *Supralabials :* Six ; the 1st and 2nd touching the nasal, 3rd and 4th the eye, and the 4th and 5th the temporal. *Sublinguals :* Two pairs, anterior larger, and in contact with three infralabials ; posterior hardly enlarged, separated from the 3rd infralabial by one scale. *Infralabials :* Three, 3rd largest and in contact with three scales behind. (Fig. 5.)

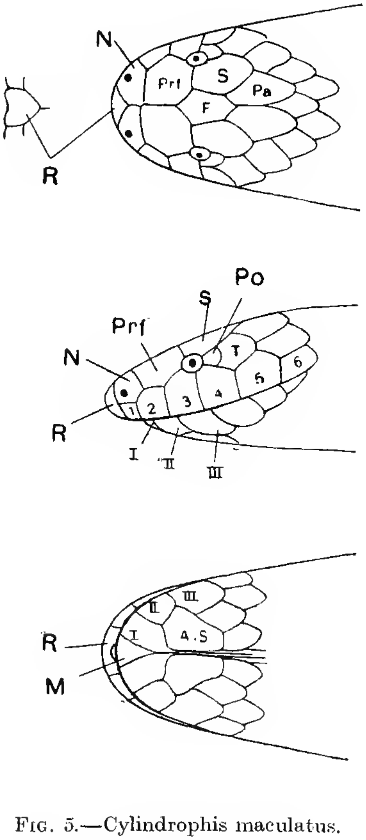

FIG. 5.—Cylindrophis maculatus.
(Life size.)

Costals: Broader than long, broadly rounded posteriorly; rectiform; smooth and glossy. Vertebral and the next row subequal; next four rows rather larger; lowest five rows subequal, and largest. Ultimate row about four-fifths the breadth of the ventrals. In 19 rows two heads-lengths behind the head, 21 in midbody, (or 19) and 19 two heads-lengths before the vent; the increase in rows occurs about six heads-lengths behind the head where a new row appears above the 4th from the ventrals; the reduction in rows posteriorly occurs about three heads-lengths before the vent, and is due to the confluence of the 5th and 6th rows above the ventrals. *Ventrals:* 185 to 212; very little broader than the ultimate row. *Anal:* Divided; one and a half times as broad as the ventrals. *Subcaudals:* 4 to 6; divided or some entire. (Fig. 6.)

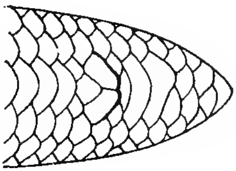

FIG. 6.—Anal region of Cylindrophis maculatus.

Dentition.—From one skull in my collection. *Maxillary:* 9. *Palatine:* 7. *Pterygoid:* 5 to 7. *Mandibular:* 11.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* A resident of the Plains. Has been found up to about 1,700 feet elevation. A very common snake.

Family **UROPELTIDÆ.**

(Named after the type Genus *Uropeltis.*)

General Characters (for Ceylon Species).—Small snakes from 1 to 2 feet in length. Head very small. Snout rounded, subacute or acute, without canthus. Eye very small, and situated in an ocular shield. Nostril small, situated in a single

shield. Mental groove absent.* Neck and anterior body much swollen, and knuckled. Body cylindrical; short, moderate, or long. Belly rounded. Tail very short, ending in a peculiar shield upon the characters of which the genera are based.

Identification.—The small head and swollen knuckled neck and forebody immediately attract attention, and the peculiar tail will further tend to indicate the family. The costals are broader than long, the breadth of the last row about two-thirds the ventrals, and the anal shield is twice or almost twice the breadth of the ventrals. Further the eye being situated in a single shield will proclaim the family.

Habits.—Subterrestrial. All are burrowing snakes that live for choice beneath the soil. The snout is used for burrowing, and not being very well adapted for this purpose a loose soil is chosen as quarters. On the surface they move slowly, and with apparent difficulty, and they are so defenceless that they fall an easy prey to any rapacious mammal, bird, or reptile. They are very timid reptiles that make no attempt to bite when handled.

Food.—All those I know subsist upon earthworms exclusively, and one rarely finds a specimen that has not fared sumptuously, or without the intestine and cloaca being distended with semiliquid mud derived from their victims.

Breeding.—All those whose habits I know are viviparous.

Poison.—They are non-poisonous.

Lepidosis.—The arrangement of the head shields is peculiar to the family. *Rostral:* Short, moderate, or long, usually compressed, and sometimes more or less keeled above; touching four or six shields. *Nasals:* Single; sometimes meeting behind the rostral. *Internasals:* Absent. *Præfrontals:* Two. *Frontal:* Present. *Supraoculars:* Absent. *Parietals:* Two. *Loreal:* Absent. *Præoculars:* Absent. *Postoculars:* Absent. *Temporals:* Absent. *Supralabials:* Four. *Sublinguals:* Absent. *Infralabials:* Three or four. *Costals:* At midbody all the rows are rectiform, broader than long, and with broadly rounded posterior borders; smooth. Vertebrals not enlarged; the breadth of the scales about four-fifths that

* Except in *Melanophidium*.

of the ultimate row. Last five or six rows gradually increasing in breadth. Ultimate row two-thirds to three-fourths the breadth of the ventrals. In 17 to 21 rows. *Ventrals:* Enlarged but narrow. *Anal:* Divided; twice or nearly twice the breadth of the ventrals. *Subcaudals:* Variable; entire or divided; few in number. *Caudal shield:* Enlarged and peculiar in shape.

Dentition.—*Maxillary:* 3 to 8; anododont, scaphiodont. *Palatine:* None. *Pterygoid:* None. *Mandibular:* 4 to 11; anododont, scaphiodont.

Distribution.—Southern India and Ceylon, mostly confined to Hills.

Key to Uropeltidæ.

(For Ceylon Species.)

Caudal shield as in fig. 8 .. Uropeltis grandis.
Caudal shield as in fig. 10 .. Silybura melanogaster.
Caudal shield as in fig. 12 .. Rhinophis.

(A) Caudal shield as long as shielded part of head.

(*a*) Rostral twice length of frontal—

Ventrals 236 to 246 .. R. punctatus
Ventrals 281 .. R. porrectus

(*b*) Rostral distinctly longer than frontal—

Ventrals 153 to 172 .. R. planiceps
Ventrals 178 to 204 .. R. trevelyanus
Ventrals 214 to 223 .. R. oxyrhynchus

(B) Caudal shield much shorter than shielded part of head—

(*a*) Ventrals 148 to 168 .. R. blythi
(*b*) Ventrals 173 to 191 .. R. drummondhayi

Genus UROPELTIS.

(Greek "oura" tail, "pelte" shield, in allusion to the curious terminal caudal shield.)

General Characters.—A small snake growing to 1½ feet. Snout rounded. Eye less than half the horizontal diameter of the ocular shield. Nostril small, in the antero-inferior quadrant of the nasal shield. Body short, stout, cylindrical, swollen, and knuckled anteriorly. Tail truncate.

Identification.—The peculiar character of the terminal caudal shield (see fig. 8) will establish the genus.

Lepidosis.—*Rostral* . Touching four shields ; not keeled, length rather shorter than the frontal, about one-third the shielded part of the head. *Nasals :* Meeting behind the rostral. *Frontal :* Longer than broad ; equal to or rather longer than the parietals. (Fig. 7.)

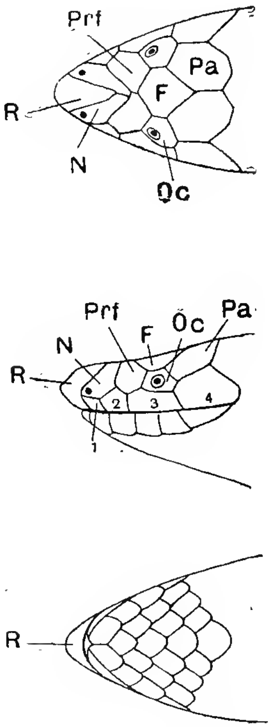

FIG. 7.—Uropeltis grandis.
(× 2.)

Costals : Last four or five rows progressively increasing in breadth. *Anal :* Twice the breadth of the ventrals. *Subcaudals :* Variable. *Caudal shield :* Nearly as long as the

shielded part of the head; studded with conical tubercles radiating from a blunt conical process in the lower central part of the shield. (Fig. 8.)

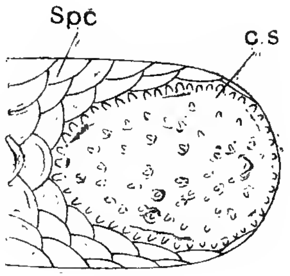

FIG. 8.—Uropeltis grandis showing top of the tail.

(× 1½.)

Dentition.—*Maxillary:* Anododont, feebly kumatodont. *Palatine:* None. *Pterygoid:* None. *Mandibular:* Anododont, feebly kumatodont. (Fig. 9.)

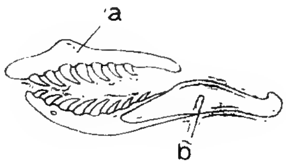

FIG. 9.—Jaws of Uropeltis grandis.

(*a*) Maxilla.

(*b*) Mandible.

Distribution.—Peculiar to Ceylon. There is only one species, viz., *grandis*.

UROPELTIS GRANDIS Kelaart.

(Latin "grandis" large; evidently meaning by comparison with its close allies.)

Kelaart's Uropeltis (or Earth Snake.)

Synonymy.—*Uropeltis philippinus, U saffragamus, U. paradalis, Pseudo-Typhlops philippinus.*

History.—Described by Kelaart in 1853.

General Characters.—As detailed under the genus. The diameter of the body is about 1/20 the total length.

Identification.—Easily recognized at once by the terminal caudal shield which is peculiar to this snake. (See fig. 8.)

Colouration.—Nearly uniform brown or blackish dorsally; lighter ventrally. When looked into closely the scales are seen to be dark basally, where overlapped by the preceding scales.

Habits.—Nothing known.

Food.—Mr. Green observed one picking grubs out of cow dung.

Breeding.—Nothing known.

Growth.—(*a*) *Early Life* My smallest specimen was 140 mm. ($5\frac{1}{2}$ inches) long.

(*b*) *Maximum Length*. 460 mm. (1 foot 6 inches long).

Lepidosis.—As detailed under the genus.

Costals Two heads-lengths behind the head 21; shortly behind this the 4th and 5th rows above the ventrals blend, and the rows then remain 19 to the vent. *Ventrals* 129 to 147. *Subcaudals*: 6 to 9.

Dentition.—From one skull in my collection. *Maxillary*: 7. *Palatine*: Edentulous. *Pterygoid*. Edentulous. *Mandibular*: 8.

Distribution.—(*a*) *General*: Peculiar to Ceylon.

(*b*) *Local*: Apparently very local and a hill snake. Has been recorded from Matura, Kandy, Matara, Badulla, and Uva District.

Apparently uncommon or very local. Mr. Drummond-Hay tells me he has never acquired a specimen.

Genus SILYBURA.

(Greek "silubon" thistle, "oura" tail, in allusion to the spines at the tail tip.)

General Characters.—Small snakes ranging between 1 and 2 feet. Head small; snout pointed, obtusely pointed, or bluntly rounded. Eye in the ocular shield. Nostrils small, round, pierced in the anterior-inferior quadrant of the nasal shield. Chin with no mental groove. Neck stout. Body short to moderate, stout, cylindrical. Belly rounded. Tail cylindrical or compressed basally, convex above, or with a flattened disc.

Identification.—The terminal caudal shield is of a character peculiar to the genus. (See fig. 10.)

Habits.—Subterrestrial. Sluggish. Very gentle.

Food.—Seem to subsist entirely on worms.

Breeding.—The method of reproduction is in many Indian species viviparous.

Poison.—Not poisonous.

Lepidosis.—*Rostral:* Touches four or six shields. *Nasals:* Meeting or nearly meeting behind the rostral. *Internasals:* None. *Præfrontals:* Present. *Frontal:* Present. *Supra-oculars:* None. *Parietals:* Present; as long as, or slightly longer than the frontal. *Loreal:* None. *Ocular:* A large shield containing the eye. *Temporal:* None. *Supralabials:* Four; 1st and 2nd touching the nasal, 2nd and 3rd the præfrontal, and 3rd and 4th the ocular. *Sublinguals:* None.

Costals: Broader than long; broadly rounded posteriorly; rectiform; smooth; vertebrals not enlarged; last three or four rows enlarged; ultimate row two-thirds to three-fourths the breadth of the ventrals. *Ventrals:* Enlarged but narrow. *Anal:* Divided; twice the breadth of the ventrals. *Supra-caudals:* Strongly keeled; forming an oval disc in many of the

species. *Subcaudals:* Divided; 5 to 15 in number. *Caudal shield:* Enlarged; with two small spines placed on a transverse ridge. (Figs. 10 and 11.)

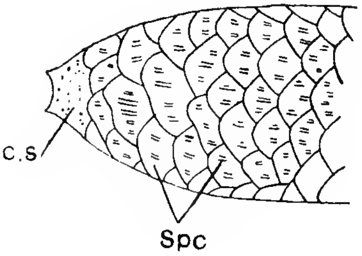

FIG. 10.—Upper part of tail of Silybura.
(× 2.)

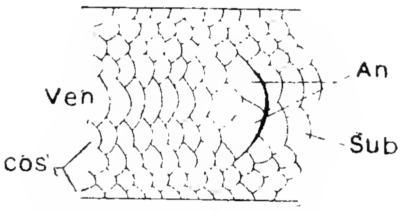

FIG. 11.—Anal region of Silybura.

Dentition.—From the skulls of five species in my collection. *Maxillary:* Anododont, kumatodont. *Palatine:* Edentulous. *Pterygoid:* Edentulous. *Mandibular:* Anododont, kumatadont.

Distribution.—Hills of Southern India and Ceylon. The genus contains twenty-two species, of which one only occurs in Ceylon; viz., *melanogaster*.

SILYBURA MELANOGASTER (Gray).

(Greek "melanos" black, "gaster" belly.)

Gray's Silybura (or Earth Snake).

Synonymy.—*Mytilia melanogaster*, *Plectrurus ceylonicus*, *Rhinophis melanogaster*, *R. blythi*.

History.—Described by Gray in 1858.

General Characters.—Head small; snout pointed. Eye less than half the length of the ocular shield. Neck and anterior body swollen and knuckled. Body cylindrical, short, robust, especially so in the adult. Belly rounded. Tail short, cylindrical, or slightly compressed.

Identification.—The terminal caudal shield will differentiate it from all other Ceylon snakes.

Colouration.—Dark brown dorsally, with yellow mottling on the sides, often forming a more or less confluent, irregular band. Black ventrally. In the young the dorsal scales are dark brown centrally, bordered with yellowish.

Habits.—Have not been remarked upon.

Food.—Nothing specially noted.

Breeding.—Nothing known.

Growth.—(*a*) *Early Life:* The young are from 90 to 100 mm. ($3\frac{1}{2}$ to 4 inches) in length.

(*b*) *Maximum Length:* 270 mm. ($10\frac{3}{4}$ inches).

Lepidosis.—*Rostral:* Touches six shields; not keeled; as long as the frontal, two-fifths the shielded part of the head. *Nasals:* Entirely separated by the rostral. *Frontal:* Longer than broad, longer than the parietals. *Costals:* Two heads-lengths behind the head 19, midbody 17, two heads-lengths before the vent 17. *Ventrals:* 141 to 166. *Subcaudals:* 6 to 10. *Supracaudals:* Strongly carinate on the flattened disc. *Caudal shield:* Enlarged; deeper than broad; ending in a transverse ridge, with two small spines placed side by side.

Dentition.—I have no skull.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* It is a hill snake, which is apparently very local. Colonel Beddonne pronounced it very common without specifying the altitude or district where he made this observation. Mr. Drummond-Hay tells me he has never met with it.

Genus RHINOPHIS.

(Greek "rhis" nose, "ophis" snake, referring to the pointed snout.)

General Characters.—Small snakes mostly about 1 foot, some nearly 2 feet in length. Head very small. Snout more or less acutely pointed. Eye small to very small, situated in an ocular shield. Nostril pierced in the antero-inferior quadrant of an entire nasal shield. Chin with no mental groove. Neck and fore body swollen and knuckled. Body cylindrical, short, moderate, or elongate. Belly rounded. Tail very short, obtusely conical.

Identification.—Easily recognized by the peculiar enlarged shield at the end of the tail, which is rough from minute spinose processes. (See fig. 13.)

Habits.—All are earth burrowers living beneath the soil. The acutely-pointed snout is not specially adapted for burrowing, and it is therefore only in loose soil that it can effect progression. The swollen neck and fore body are due to a remarkable muscular development, by which the snake is enabled to push its way through the soil. They are all extremely defenceless reptiles that fall an easy prey to raptorial mammals and birds and other snakes of ophiophagous habits. They never attempt to bite, no matter how great the provocation.

Food.—All those whose diet has been ascertained feed on earthworms and they eat voraciously. Hardly a specimen is found that has not fragments of worms in the stomach, and none without the intestinal tract loaded with semi-liquid mud derived from the worms upon which they subsist.

Breeding.—All whose habits are known are viviparous, and they are not prolific, usually producing from two to six young at a time.

Lepidosis.—*Rostral :* Usually more or less compressed, sometimes keeled above. *Nasals* Completely separated by the rostral; touching the 1st and 2nd supralabials. *Præfrontals :* Touching the 2nd and 3rd supralabials.

Frontals : Variable in length. *Parietals :* Variable in length. *Ocular :* Contains the eye; touching the 3rd and 4th supralabials. *Supraoculars :* Absent. *Loreal :* Absent. *Præoculars, postoculars,* and *temporals :* Absent. *Supralabials :* Four ; progressively increasing in size from before backwards.

Costals : Broader than long, subequal except the ultimate row, which is broader than the rest, broadly rounded posteriorly ; smooth. In from 21 to 19 rows two heads-lengths behind the head, two less, *i.e.*, 19 to 17 at midbody and to the vent. The rows reduce anteriorly by a fusion of the 4th and 5th rows above the ventrals. *Ventrals :* About four-thirds the breadth of the ultimate row of scales; narrow, so that three or four rows of scales can be seen each side when the specimen is laid on its back. *Anal :* Divided ; fully twice the breadth of the ventrals. *Subcaudals :* 3 to 10 ; mostly divided, some usually entire. *Caudal shield :* Enlarged and peculiar in shape, covered with minute spinose processes; as long or nearly as long as the shielded part of the head. (Fig. 12.)

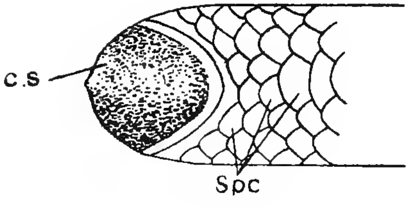

FIG. 12.—Upper part of tail of Rhinophis.

Dentition.—From five species in my collection. *Maxillary :* Anododont, kumatodont. *Palatine :* Edentulous. *Pterygoid* Edentulous. *Mandibular :* Anododont, scaphiodont.

Distribution.—South India and Ceylon, mostly confined to the hills. There are nine species, seven of which are peculiar to Ceylon. Two of these are now described for the first time, viz., *drummond-hayi* and *porrectus.*

RHINOPHIS OXYRHYNCHUS (Schneider).

(Greek "oxus" sharp, "rhynchos" snout.)

Schneider's Rhinophis (or Earth Snake).

Synonymy.—*Typhlops oxyrhynchus, Depatnaya lankadivana. Mytilia unimaculata.*

History.—Described and christened by Schneider in 1801.

General Characters.—The largest of the genus growing to 22 inches. Head small, snout very acute, keeled above. Eye very small, less than one-third the horizontal diameter of the ocular shield. Body moderately long, its diameter at midbody being about one thirty-fifth to one fortieth the total length. Tail short.

Identification.—The caudal shield about as long as the shielded part of the head, rostral longer than the frontal, and ventrals less than 230 if taken together will denote the species.

Colouration.—Head dark brown without marks. Body scales dark brown, the basal part darkest, and with lighter margins. The ventral rows are outlined with whitish. A few quite white ventral patches before the anus.

Habits.—Kelaart says it frequents ant hills, and may be found as deep as 2 or 3 feet beneath the soil.

Food.—Nothing known.

Growth.—*Maximum Length:* A very fine male (?) specimen in the Colombo Museum measures 573 mm. ($22\frac{1}{2}$ inches).

Lepidosis.—*Rostral:* Sharply keeled above, length greater than frontal, about half the shielded part of the head. *Frontal:* About as broad as long, as long as the parietals.

Costals: Two heads-lengths behind the head 21 or 19, midbody 19 or 17, two heads-lengths before the vent 19 or 17. All rows subequal except the ultimate, which is rather the broadest. *Ventrals:* 211 to 227. *Subcaudals:* 5 to 7.

Caudal shield: About as long as the shielded part of the head.

Dentition.—I have no skull.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Reported by Kelaart common at Trincomalee.

The single specimen in the Colombo Museum I found labelled *Uropeltis grandis.* This may be the specimen referred to by Ferguson from Mullaittivu.

RHINOPHIS PUNCTATUS Muller.

(Latin "punctatus" literally pricked, implies minutely spotted.)

Muller's Rhinophis (or Earth Snake).

Synonymy.—*Pseudo-Typhlops oxyrhynchus.*

History.—Described and christened by Muller in 1832.

General Characters.—Grows to about 15 inches. Head very small. Snout acutely pointed, sharply keeled above. Eye very small, being about one-third the horizontal diameter of the ocular shield. Body rather long, its diameter at midbody being about one forty-seventh to one forty-ninth the total length. Tail short.

Identification.—The caudal shield about half the length of the shielded part of the head, rostral longer than the frontal, and from 236 to 246 ventrals if taken together will establish the species.

Colouration.—The head blackish-brown with no marks. Body scales dark brown centrally, whitish marginally. The eighth row from the ventrals is wholly whitish.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—*Maximum Length :* 390 mm. ($15\frac{1}{2}$ inches).

Lepidosis—*Rostral :* With a sharp keel above ; length greater than the frontal, about half the shielded part of the head. *Frontal :* As broad as long, as long as the parietals.

Costals : Two heads-lengths behind the head 19, midbody 17, two heads-lengths before the vent 17. *Ventrals:* 236 to 246. *Subcaudals :* 5 to 7. *Caudal shield .* About as long as the shielded part of the head.

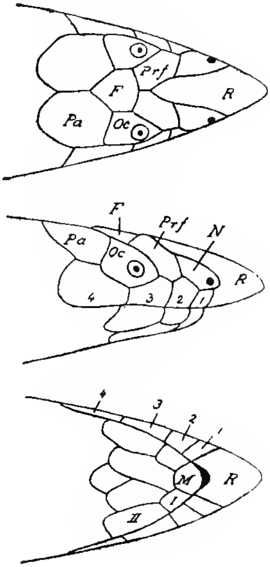

FIG. 13.—Rhinophis punctatus.

(× $\frac{3}{4}$.)

Dentition.—I have no skull.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Apparently rare. There are four in the British Museum, two of which are from Peradeniya. Not represented in the Colombo Museum.

RHINOPHIS PORRECTUS Spec. nov.

(Latin " porrectus " stretched.)

Willey's Rhinophis (or Earth Snake).

Synonymy.—*Rhinophis punctatus* (Willey. Spol. Zeylan., Vol. I., 1903, pp. 88 and 89).

History.—The type specimen was captured by Dr. Willey in 1903 and confused by him with *R. punctatus* (Muller).

General Characters.—A small species growing to 14 inches. Head very small. Snout acute with sharp keel above. Eye very small, less than one-third the horizontal diameter of the ocular shield. Body very elongate, its diameter at midbody about one seventy-sixth the total length. Tail short.

Identification.—Most easily recognized by the very numerous ventral shields which number 281 in the " type."

Colouration.—Head blackish-brown without markings, tip of snout dull orange. A narrow blackish-brown vertebral line passes from the nape to the supra-anal region, occupying the median part of the vertebral row. The outer part of the vertebral, the whole of the next row, and the edge of the seventh from the ventrals are whitish. The contiguous halves of the seventh and sixth rows from the ventrals are blackish-brown. All the remaining rows are blackish-brown with whitish margins. Caudal shield dull orange with a subterminal dark band.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—*Maximum Length :* 355 mm. (14 inches).

Lepidosis.—*Rostral :* Sharply keeled above, length fully twice the frontal, more than half the shielded part of the head. *Frontal :* As broad as long, decidedly shorter than the parietals.

Costals : Two heads-lengths behind the head 19, midbody 17, two heads-lengths before the vent 17. All rows subequal except the ultimate, which is slightly the broadest. *Ventrals :* 281 ; about four-thirds the breadth of the ultimate row. *Anal :* Divided ; twice as broad as the ventrals. *Subcaudals :* 6. *Caudal shield :* Three-fourths to four-fifths the shielded part of the head.

Dentition.—I have no skull.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Known from a single specimen in the Colombo Museum, encountered by Willey on the road between Puttalam and Chilaw. Hence apparently a Low-country species.

RHINOPHIS PLANICEPS Peters.

(Latin " planus " flat, " ceps " head.)

Peters's Rhinophis (or Earth Snake).

Synonymy.—*Typhlops philippinus, Rhinophis philippinus.*

History.—Described by Cuvier under the name *Typhlops philippinus* in 1829, under the belief that the type came from the Philippine Islands. Peters in 1861 referred to it under the same title, and described another species as *R. planiceps*, which subsequent writers could not dissociate from the former. As Cuvier's name is misleading, it has been dropped in favour of that given by Peters.

General Characters.—Grows to about 11 inches. Head very small. Snout acute, obtusely keeled above. Eye very small, less than one-third the horizontal diameter of the ocular shield. Body short, its diameter at midbody about one twenty-fourth to one thirty-fourth the total length. Tail short.

Identification.—The caudal shield as long as shielded part of head, the rostral longer than the frontal, frontal as broad as long, and ventrals 180 or less will differentiate this from the other species.

Colouration.—Head dark purplish-black without marks. Body dark purplish-black with a series of irregularly ovate, or subtriangular, vertical, whitish spots most conspicuous anteriorly. The ventrals and the scales of the lowest four or

five rows each side outlined with white. Anal region, side of tail, and caudal shield whitish. No dark horseshoe on caudal shield.

Habits.—Very gentle and disinclined to bite.

Food.—The stomachs of many investigated by me contained nothing but earthworms, and the intestines and cloaca were distended with semi-liquid mud from the same source.

Breeding.—(*a*) *The Sexes :* Of thirty-two adults in Mr. Drummond-Hay's collection sexed by me, nineteen proved to be males and thirteen females. Males have relatively longer tails, and more numerous subcaudals. The sexes appear to grow to about the same length. The longest male examined was 252 mm. (10 inches), and the longest female 240 mm. ($9\frac{5}{8}$ inches).

(*b*) *Method of Reproduction :* I found eggs containing embryos in such a stage of development as to leave no doubt that the species is viviparous.

(*c*) *Season :* As no dates were available, no light could be thrown upon this matter.

(*d*) *The Brood :* The two gravid females dissected by me each contained two embryos.

Growth.—(*a*) *The Young :* When born the young are evidently about 90 to 95 mm. ($3\frac{5}{8}$ to $3\frac{3}{4}$ inches) long. I have measured post-natal specimens as small as 90 mm. ($3\frac{5}{8}$ inches).

(*b*) *Early Life :* The growth cannot be followed as no dates were available.

(*c*) *Maturity :* The gravid females were 182 and 196 mm. ($7\frac{1}{4}$ and $7\frac{7}{8}$ inches) long. If this snake grows at the same rate as the majority of snakes, and doubles its length in the first year of life, these measurements indicate that it is sexually mature when a year old.

(*d*) *Maximum Length :* The longest male I have examined was 252 mm. (10 inches) and the longest female 240 mm. ($9\frac{5}{8}$ inches). Gunther, however, records one 420 mm. ($16\frac{1}{2}$ inches), sex not specified.

Lepidosis.—*Rostral :* Obtusely keeled above ; length longer than the frontal, less than half the shielded part of the head. *Frontal :* As broad as long, as long as the parietals.

Costals Two heads-lengths behind head 19, midbody 17, two heads-lengths before vent 17. *Ventrals :* 161 to 182 (♂ 161 to 176, ♀ 168 to 182) (152 Boulenger). *Subcaudals :* 3 to 6 (♂ 4 to 6, ♀ 3 to 4). *Caudal shield :* About as long as the shielded part of the head.

Dentition.—From one skull in my collection. *Maxillary :* 6 ? to 7 ? *Palatine :* Edentulous. *Pterygoid :* Edentulous. *Mandibular :* 8 ?

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Mr. Drummond-Hay tells me it is a common snake in the Ratnagiri, Balangoda, and Yatiyantota Districts in hills below about 3,000 feet elevation. Twenty-two in the Colombo Museum labelled *trevelyanus* from the Bulatota estate, Rakwana District, Province of Sabaragamuwa, are *planiceps*.

Rhinophis trevelyanus (Kelaart) (named in honour of Mr. Trevelyan).

Trevelyan's Rhinophis (or Earth Snake).

Synonymy.—*Depatnaya trevelyana*, *Mytilia gerrardi*, *Rhinophus homolepis*.

History.—Described and christened by Kelaart in 1853.

General Characters—Grows to about 11 inches. Head small. Snout acute, keeled above. Eye very small, less than one-third the horizontal diameter of the ocular shield. Body short; the diameter at midbody about one twenty-sixth to one-thirtieth the total length. Tail very short.

Identification.—The caudal shield as long as the shielded part of the head, rostral longer than frontal, and ventrals 188 to 204 will distinguish this from the other species.

Habits.—Gunther says it has been found 3 or 4 feet beneath the soil.

Food.—The many I examined had taken nothing but earthworms.

Breeding.—(*a*) *The Sexes:* Out of a series of thirty-four in Mr. Drummond-Hay's collection, nine were males and twenty-five females. Males have slightly longer tails. Females attain to a somewhat greater length.

(*b*) *Method of Reproduction:* It is viviparous in habit. I found many gravid and extracted fœtuses from 85 to 90 mm. in length ($3\frac{3}{8}$ to $3\frac{5}{8}$ inches).

(*c*) *Season:* Not known, as no dates were available.

(*d*) *The Brood:* The eight gravid females examined by me contained from two to four eggs or sacs. It was noticed that the longest dams were the most prolific.

Growth.—(*a*) *The Young:* At birth the young are about 87 mm. ($3\frac{1}{2}$ inches), for the male fœtuses measuring 85 to 90 mm. had not extruded claspers. The smallest post-natal specimen measured 113 mm. ($4\frac{1}{2}$ inches).

(*b*) *Early Life:* Lack of dates made it impossible to follow the early growth.

(*c*) *Maturity:* The smallest prospective mother measured 194 mm. ($7\frac{3}{4}$ inches). If this species doubles its length in the first year of life as so many snakes do, it is producing young when only one year old.

(*d*) *Maximum Length:* The longest male I have seen was 225 mm. (9 inches), and the longest female 250 mm. (10 inches). Boulenger gives the extreme measurement as 275 mm. (11 inches) without specifying the sex.

Lepidosis.—*Rostral:* Keeled above; longer than the frontal, less than half the shielded part of the head. *Frontal.* As broad or almost as broad as long, as long as the parietals.

Costals: Two heads-lengths behind the head 19, midbody 17, two heads-lengths before the vent 17. *Ventrals:* 188 to 204 (♂ 188 to 193, ♀ 191 to 204). *Subcaudals:* 2 to 5 (♂ 5, ♀ 2 to 3). *Caudal shield:* As long as the shielded part of the head.

Dentition.—From two skulls in my collection. *Maxillary.* 5 to 6. *Palatine:* Edentulous. *Pterygoid:* Edentulous. *Mandibular:* 7 ?

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local :* Mr. Drummond-Hay tells me it is a common snake in the low hills of the Balangoda, Ratnagiri, and Yatiyantota Districts below about 3,000 feet. All the specimens in the Colombo Museum (twenty-three) labelled *trevelyanus*, except one, proved to be *R. planiceps*.

Rhinophis blythi Kelaart.

(Named in honour of Mr. Blyth.)

Blyth's Rhinophis (or Earth Snake).

Synonymy.—*Mytilia templetoni.*

History.—Described and christened by Kelaart in 1853.

General Characters.—A small snake growing to about 14 inches. Head small. Snout acute, not keeled above. Eye less than half the horizontal diameter of the ocular shield. Body short; its diameter at midbody about one twenty-second to one thirty-second the total length. Tail short.

Identification.—The caudal shield much shorter than the shielded part of the head, with ventrals ranging between 148 and 168 will differentiate this from its allies.

Colouration.—Head blackish-brown above, with a more or less distinct, narrow, white √ with its apex on the rostral, and the limbs confluent with a vertical, white, lateral spot on the neck. Body blackish-brown above, with a series of whitish, vertical, or sub-triangular, lateral spots most conspicuous anteriorly, the most anterior sometimes meeting over the neck. These are sometimes confluent to form an irregular lateral stripe. Belly dappled with blackish-brown and white, many scales being margined with white. Anal region whitish. Tail with a basal white band incomplete dorsally.

Habits.—Lives like the other species beneath the soil. Very inoffensive, never attempting to bite.

Food.—Those I have investigated had eaten nothing but earthworms. It seems to feed voraciously on this fare, and the intestines in consequence are found loaded with semi-liquid mud.

Breeding.—(*a*) *The Sexes :* Of seventy-two specimens in Mr. Drummond-Hay's collection examined by me, thirty-two proved to be males and forty females. The sexes, as a rule, grow to about the same length, but the largest specimen proved to be a female. The tail is somewhat longer in males.

(*b*) *Method of Reproduction :* The species is viviparous. I have seen many gravid females near term, and there is a specimen in the Colombo Museum preserved in the act of parturition, about 55 mm. (2¼ inches) of a youngster protruding from the cloaca.

(*c*) *Season :* There are unfortunately no dates available for Mr. Drummond-Hay's specimens. The parturient dam above alluded to was killed at Hatton in August, 1912.

(*d*) *The Brood :* This is apparently the most prolific of the species of this genus, the brood varying from three to six. On one occasion I have found three, on three occasions five, and once six. The smallest mothers are the least productive as I so frequently find with snakes.

Growth.—(*a*) *The Young :* The longest unborn young I have measured were 88 and 94 mm. (3½ and 3¾ inches). I have seen post-natal specimens that measured 100 mm. (4 inches).

(*b*) *Early Life :* I have not been able to follow the growth for lack of dates.

(*c*) *Maturity :* The smallest of six gravid females was 225 mm. (9 inches). If as is probable this species grows like other snakes, and doubles its length in the first year of life, the species is propagating when about one year old.

(*d*) *Maximum Length :* Most adults of both sexes are about 275 mm. (11 inches) long. The largest I have measured was a female 368 mm. (14½ inches).

Lepidosis.—*Rostral :* Not keeled above ; length equal to that of the frontal, about two-fifths the shielded part of the head. *Frontal :* Longer than broad, longer than the parietals. *Costals :* Two heads-lengths behind the head 19, midbody 17, two heads-lengths before the vent 17. *Ventrals :* 148 to 168

(♂ 148 to 155, ♀ 159 to 168). *Subcaudals :* 3 to 9 (♂ 5 to 9, ♀ 3 to 5). *Caudal shield :* About two-thirds the shielded part of the head.

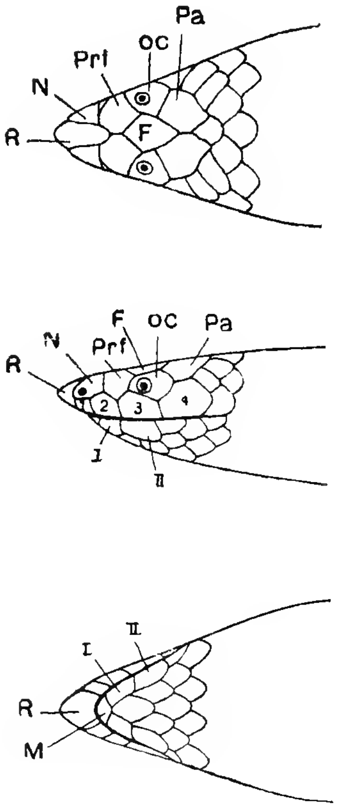

FIG. 14.—Rhinophis blythi.

(× 3.)

Dentition.—From one skull in my collection. *Maxillary :* 6. *Palatine .* Edentulous. *Pterygoid :* Edentulous. *Mandibular :* 10.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Apparently the commonest of the Ceylon Rhinophids. Mr. Drummond-Hay tells me it was very common at Hopewell estate, Balangoda District, between about 3,000 and 4,200 feet. It has been recorded from Punduloya and Hatton.

RHINOPHIS DRUMMONDHAYI Spec. nov.

(Named in honour of Mr. H. M. Drummond-Hay
by the Author.)

Drummond-Hay's Rhinophis (or Earth Snake).

Synonymy.—Nil.

History.—On examining Mr. Drummond-Hay's collection, I found nine examples of a snake which is new to science. I also extracted one similar specimen from the stomach of a Ceylon Krait (*Bungarus ceylonicus*), and another probably of this species from another Ceylon Krait.

General Characters.—A small species very similar to *planiceps* and *trevelyanus* and growing to similar proportions. Head small. Snout acute, hardly compressed, with no keel above. Eye small, less than half the horizontal diameter of the ocular shield. Body short; its diameter at midbody about one twenty-fifth to one thirty-fifth the total length.

Identification.—The caudal shield much shorter than the shielded part of the head, and ventrals ranging between 173 to 191 will indicate the species.

Colouration.—Head dark brown with no marks. The scales on the body are brown dorsally, margined with blackish-brown, except anteriorly, where the scales are variegated with whitish streaks. No lateral whitish spots. Ventrally beautifully dappled brown and whitish. Anal region whitish. Tail blackish above and below, with a whitish lateral stripe ending subterminally.

Habits.—Nothing special noted.

Food.—The stomachs of several investigated by me contained earthworms, and the intestine and cloaca were distended with semi-liquid mud from the worms ingested.

Breeding.—(*a*) *The Sexes :* Of thirteen specimens examined, four proved to be males and nine females. The sexes appear to grow to much the same length, but the largest was a female. In males the tail is rather longer.

(*b*) *Method of Reproduction :* It is viviparous in habit.

(*c*) *Season :* Not known, no dates being available.

(*d*) *The Brood:* From two to five young are produced at a time.

Growth.—(*a*) *The Young :* The exact length at birth could not be ascertained from the specimens available.

(*b*) *Early Life :* Not known, no dates being on record.

(*c*) *Maturity :* The smallest of four gravid females was 280 mm. (11⅛ inches).

(*d*) *Maximum Length :* The longest male was 298 mm. (11¾ inches), and the longest female 330 mm. (13 inches).

Lepidosis.—*Rostral :* But slightly compressed ; not keeled above ; length equals frontal, about two-fifths the shielded part of the head. *Nasals :* Completely separated by the rostral ; touching the 1st and 2nd supralabials. *Præfrontals :* Touching the 2nd and 3rd supralabials. *Frontal :* As broad as long, length equals parietals. *Supralabials :* Four.

Costals : Two heads-lengths behind head 19, midbody 17, two heads-lengths before vent 17. All rows subequal except the ultimate, where the scales are broadest. *Ventrals :* 173 to 191 (♂ 173 to 180, ♀ 181 to 191) ; about four-thirds the breadth of the ultimate row. *Anal :* Divided ; fully twice the breadth of the ventrals. *Subcaudals :* 4 to 7 (♂ 5 to 7, ♀ 4 to 6) ; usually divided, some frequently entire. *Caudal shield :* Much shorter than the shielded part of the head.

Dentition.—From two skulls in my collection. *Maxillary :* 7. *Palatine :* Edentulous. *Pterygoid :* Edentulous. *Mandibular :* 8.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Mr. Drummond-Hay tells me it is fairly common on Lennock estate in the centre of the Uva Patnas at about 4,000 to 4,200 feet. One specimen from Mr. Ormiston was killed on Kalupahani estate, Haldummulle District, about 3,000 feet.

Family **BOIDÆ.**

(Named after the type Genus *Boa*.*)

General Characters.—This family includes the largest snakes that are known, such as the Pythons, the Boas, and the Anaconda. The head is more or less depressed, the snout rather long, without canthus, and broadly rounded anteriorly. The eye is small with a vertical pupil. The nostril is placed rather high on the side of the snout between two or three shields. The chin may reveal a mental groove or not. The body is massive, attenuating towards the neck and posteriorly. Rudimentary hind limbs are present, the extremities of which are visible as claw-like processes on either side of the vent. Those I have dissected out consist of two bones, the analogues of the femur, and tibia of mammals. The former is not articulated to any pelvic bone, but lies completely free. The tibia is articulated to the femur. The belly is rounded. The tail is short, and prehensile in many of the species.

Identification.—The costals are longer than broad, and the scales in the last row about half the breadth of the ventrals. The anal is as broad as the ventrals.

Habits.—They are subterrestrial, terrestrial, or semi-aquatic. Very sluggish by nature, they do not pursue their prey, but conceal themselves, some by burrowing, some in water, and others in trees, and rely on their victims coming within their grasp. Once the victim is seized, life is quickly exterminated

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* (From *Boa* one of tho genera of the family. *Boa* is derived from Latin "*bos*" a cow, and is based on the old fable that some, or one, of the species sucked the milk from cows.)

Linné (1738 to 1783) says that Pliny (23 to 79 A.D.) mentions the story of the boa sucking the milk from cows.

Topsell in his "Historie of Serpents" (1608) says: "The Latines called it (*Boa constrictor ?*) "boa" or "bova" because by sucking cowe's milke it so encreaseth, that in the end it destroyeth all manner of herds, cattell, and regions." Cordante, too, says:

"The Boas serpent which Italy doth breede
Men say, uppon the milke of cowes doth feede."

by constriction. Their movements are slow ; in fact, in some progression cannot be called anything but a crawl. The reason for this appears to be that the ribs are excessively bowed to permit of the attachment of their extremities to the sides of the very narrow ventral shields. The effect is that a very narrow " foot " sustains the massive weight of the body, and militates against active progression.

Breeding.—Some are viviparous others oviparous.

Food.—Mammals chiefly, but birds and reptiles are also taken.

Poison.—Not poisonous.

Lepidosis.—Different in the two sub-families (q. v.)

Dentition.—Different in the two sub-families.

Distribution.—South Eastern Europe, Central and South Asia, Africa, Australia, Western North America, Central and South America, and West Indies.

The family is divided into two sub-families, Pythoninæ and Boinæ.

Sub-family **Pythoninæ.**

Genus PYTHON.

(Named from the fabled monster of Grecian mythology killed by Apollo in the Pythian Vale near Mount Parnassus.*)

General Characters.—Large snakes attaining to 10 and 15 feet or more. Head nearly as broad as the body, depressed. Snout long, broadly rounded, and without any canthus. Eye moderate with vertical pupil. Nostril large, placed high on

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* Milton refers to the fable in the following lines :—

" but still greatest he the midst
Now dragon grown, larger than whom the sun
Engendered in the Pythian Vale on slime
Huge Python ; and his power no less he seemed
Above the rest still to retain."

(Paradise Lost, Book X., line 528, *et. seq.*)

the snout. Chin with a mental groove. Neck fairly evident. Body cylindrical, massive. Belly rounded. Terminations of the concealed rudimentary limbs seen as small claw-like processes on each side of the vent. Tail short, prehensile.

Identification.—Costal rows more than sixty in midbody. Ventrals about twice the breadth of the last costal row. Anal entire; as broad as the ventrals.

Habits.—Terrestrial, arboreal, subaquatic, sluggish. Movements slow.

Food.—Omnivorous, showing some partiality to a mammalian fare.

Breeding.—Oviparous except *regius*, which is viviparous.

Poison.—Non-poisonous.

Lepidosis (Indian Species).—*Rostral :* Touches six shields; with a wedge-shaped pit on each side. *Internasals :* A pair. *Præfrontals :* A pair; separated from the frontal and supraoculars by a series of small scales. *Frontals :* A pair. *Supraoculars :* Present. *Parietals :* Absent. *Nasals :* Three; the anterior largest. *Loreals :* Many, small. *Præoculars :* Three or four. *Postoculars :* Three or four. *Temporals :* Replaced by small scales. *Supralabials :* Eleven to fourteen; first two or three with cuneate pits; two touching the eye. *Sublinguals:* Absent; replaced by small scales. *Infralabials :* Many; a few of the anterior and posterior with roundish pits.

Costals : At midbody. Longer than broad dorsally; rectiform; smooth. Vertebrals not enlarged, about one-seventh the breadth of the last row. Antepenultimate row about as broad as long. Penultimate row broader than long. Ultimate row broadest, and about half the breadth of the ventrals. In 60 to 75 rows in midbody. *Ventrals :* Enlarged; 242 to 330. *Anal :* Entire; as broad as the ventrals. *Subcaudals :* Divided; 61 to 102.

Dentition.—*Præmaxillary :* 4. *Maxillary :* 16 to 19; scaphiodont. *Palatine :* 6 or 7; scaphiodont. *Pterygoid :* 8 to 10; feebly scaphiodont. *Mandibular :* 16 to 19; scaphiodont.

Distribution.—Tropical and South Africa, South Eastern Asia, Papuasia, Australia. The genus includes nine species, of which one, viz., *molurus*, occurs in Ceylon.

PYTHON MOLURUS Linné.

(Greek "molouros" some kind of snake, the identity of which is now uncertain.)

The Indian Python.

Tamil: "periya pambu" (large snake), "malai pambu" (hill snake), "kaloodai viriyan" (ass viper). *Sinhalese:* "pimbera"* (Ferguson).

Synonymy.—*Coluber molurus, Boa ordinata, B. cinerea, B. castanea, B. albicans, B. orbiculata, Python bora, P tigris, P. ordinatus, P. bivittatus.*

History.—The snake depicted in 1734 by Seba on Plate XXXVII., fig. 1, of his "Thesaurus" appears to be this species. It is said to be from India, but its name "ninti polonga" indicates Ceylon. Our oldest zoologists used "India" in a very inexact manner. It was described by Linné in 1766. Subsequently Russell in 1796 figured it no less than four times in his first volume. (Plates XXII., XXIII., XXIV., and XXXIX.)

Identification.—There are over 60 rows of costals at midbody. This alone will identify the snake. In addition, the python presents curious depressions on the rostral, and the two first labials, which are seen in no other Ceylon snake.

Colouration.—On the head the marks vary a good deal with age, and in all individuals vary much according to whether

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* According to the famous John Ray the word anaconda is Sinhalese, and not South American as one might suppose. His friend Dr. Tancred Robinson gave him a catalogue of the Indian snakes he had noted in the Leyden Museum. No. 8 on this list read as follows:—"8 serpens indicus bubalinus anacondaia zeylonibus, idest bubalorum aliorumque jumentorum membra conterens." Yule says he can find no mention of the name anaconda in old South American literature, and suggests that it is derived from the Sinhalese "anai" elephant, and "kondra" which vanquished. I am told that the Tamil is "anai" elephant, and "kolra" killer.

desquamation has been recently completed, or is impending. The ground colour is grayish, whitish, or yellowish in adults, and often a very pretty shade of pink, in the young especially. There is a dark streak from the nostril to the eye in the young, which often is completely obliterated in later life. Behind the eye at all ages is a conspicuous, dark, oblique band to the gape, and a more or less conspicuous patch below the eye tending to become obscure with age. On the front part of the lower lip there is often some fine mottling. On the back of the head and the nape is a large lance-shaped mark bisected in the median line, but this often fades so much anteriorly in adults that the similitude to a lance is more or less effaced. The light bisecting band, together with similar light bands, one of which passes over each eyebrow—especially distinct in the young—are very suggestive of the " dasira " mark of the Tamils.

Dorsally the body is grayish or yellowish, and bears a series of large, somewhat roughly-quadrate patches, extending from the neck on to the tail. These patches, which are centrally much the same colour as the ground, are well defined outwardly, and broadly outlined with black or blackish, and it is here that those lovely bluish and amethystine hues are seen in certain lights which show off the snake to such advantage, and which many an artist in the Royal Academy has tried, with varying degrees of success, to depict. Outside this median series of marks is another small series of a similar character, and outside this again a third sometimes, much less regular and smaller, and mixed up with a coarse mottling extending into the flanks. The underparts are dirty-whitish, or faintly yellow. Seen in the sun's rays the iridescent effects on the dorsal patches defy alike the author's powers of description and the painter's art of reproduction. Virgil's* description, however, of the snake that encircled the tomb of

* " Scarce had he said when from the shrined base a slippery snake trailed huge seven coils, in each seven folds ; and circling tranquilly the tomb slid o'er the altar ; dark blue streaks its back lit up, its scales a sheen of spotted gold as (when the sun shines opposite) the bow darts from the clouds a thousand varied hues." Aeneid Lib. V. line 84, *et seq.*

Anchises, and which Kennedy has so graphically rendered in English verse as follows, leaves no doubt, but that it is a python that is indicated, and as likely as not our Indian species *molurus* :—

Habits.—(*a*) *Haunts* For the most part the Indian python is a jungle inhabitant. It may be met with in the interior of the densest forest tracts, or in sparser forest growth such as that which clothes the rocky slopes of many low hills. Where jungle is not available it most usually attaches itself to rivers and jheels, especially the former. In jungle areas it is frequently observed in trees and at times at some considerable elevation aloft. It climbs stealthily and well, and having established itself in the branches secretes itself so well that it is no infrequent event for a monkey to come within striking distance, and forfeit its life. By means of its prehensile tail it is capable of suspending itself from branches, nearly all of its body remaining free, and there is no doubt that many an incautious animal comes within reach, and is victimized. Mr. Sharpe, D.S.P., in the Fyzabad District, told me in 1906 that he once climbed up into a banyan tree in dense jungle with his shikari, who told him that at that season, when the fruit was ripening, many animals, especially deer, visited these trees to eat the fallen fruit. After having been quiet for some time, he noticed close to him a movement in what he had up till then taken to be an aerial root, but which on closer inspection proved to be a python suspended by its tail, and evidently established there for the same purpose that had actuated the sportsman. I have heard of pythons quartering themselves in hollow trees, and frequenting those on which egrets and night herons roost, to which at night the snake stealthily crept and successfully took toll.

In water this snake is quite at home, in fact it might be considered semi-aquatic in habit. It swims deftly and strongly, when its inclination prompts such activity, but is often to be observed partially or wholly submerged near the bank of a river, or jheel. As in captivity, it will lie for hours showing nothing but the tip of its snout, which is pushed out to raise the nostrils above the surface, and permit breathing. It can remain beneath the water entirely for many minutes.

Colonel Fife Cookson* says that observations were made at Regent's park, which showed that it could keep entirely submerged for half an hour. I asked the attendant at Cross's Menagerie in Liverpool some years ago to make special observations in this direction, and he told me later that one kept its head below the water for 11 minutes, and remained above 9 minutes subsequently before again retiring below. Another kept below 12 minutes, and another 15 minutes.

If only partially submerged in water in its native haunts, it keeps so still that any part of the body exposed is likely to be taken for a branch or root. My informant at Cross's Menagerie also told me that one kept in its bath from Wednesday till Sunday of one week, and often the sloughing period is passed in their tanks, from which the snake emerges resplendent in its new attire.

Occasionally the python has been reported at sea, but it is probable that it has drifted thence on a log, or in the current of a flooded river. It shows no special affection for the sea.

(*b*) *Disposition* : Our Indian python is one of the most lethargic of snakes, and as such an uninteresting creature in the vivarium. In captivity it passes the day in lazy apathy, sometimes lying upon, or partially encircling, the branch usually put into its cage, sometimes convoluted into a heap on the floor, or as frequently reclining partially or wholly immersed in its bath of water. In any of these attitudes it is familiar enough to every one who has visited the reptile house in our various zoological gardens. It is wont to lie for hours together without a movement in spite of the stream of spectators peering into its cage, and their repeated attempts, usually in vain, to rouse it to activity by drumming upon the glass, flourishing handkerchiefs, and other objects before it. This apathy many might suppose the outcome of a familiarity which breeds contempt, even in animals that are naturally of a fierce disposition, but even in its natural haunts it seems to behave in very much the same way, exhibiting little if any

* Tiger shooting in the Doon and Ulwar, p. 31.

timidity, rarely rousing itself seriously to escape, and even when attacked making no attempt to avenge offence or injury. It thus becomes an easy victim to those who seek to kill it, or an easy capture to those of a more courageous and venturesome spirit. Even the female that shows such unremitting devotion to her parental duty of incubation will suffer herself to be captured with her brood of eggs with little or no remonstrance. In Travancore in 1903 a 15-foot dam, with eggs as it proved on the verge of hatching, allowed herself to be boxed, and conveyed to Trivandrum without offering any resistance. Similarly, in Balrampur, Mr. Oakes told me that two large pythons, one a dam incubating eggs, were easily captured alive and brought in from the jungle, the female continuing her duties and successfully hatching out her eggs. Six- to eight-foot pythons have several times been brought in to me found basking on a log, or in a boat on the river. These seemingly allowed themselves to be captured by a couple of coolies with little or no attempt at escape, though nothing could have been easier than one wriggle and a plunge into the water. Father Dreckman met with one just under 20 pounds in weight when walking with a friend in jungle. It was seen leisurely crossing their path. His friend went for its tail, while Father Dreckman negotiated the head, expecting a hard struggle, but except for an ineffectual snap at his face, the snake allowed its neck to be seized, and its head to be thrust into a bag, into which the rest of its body was unceremoniously huddled without remonstrance.

Its size, beauty, and placid disposition make it a welcome addition to the snake charmer's stock-in-trade, so that scarcely a member of the fraternity is without one. It is therefore in India a very familiar creature to everyone. The juggler produces his specimen with some ostentation from a bag or basket, seeking to impress the onlookers, and he trades upon the spectators' natural fears, for if one comes forward too close to inspect the creature, it is more than likely that the owner affects the greatest alarm for his safety, as though to foster the belief already prevalent in the assembled throng, that it is to him, and him only, that the snake is a peacefully inclined and harmless creature.

(*c*) *Strength:* It seems very strange that a creature possessing such a massive and muscular body, and such gigantic strength that it can overpower a leopard with ease, does not show a more aggressive spirit. Few people who have not handled a python in life can have any conception of the strength at its command. A brother of mine in the Straits told me he had several times measured large pythons in life, and that it takes as many coolies as one can put in the length of the snake to hold it, and even then they were unable to straighten it properly. Buckland* relates an incident which happened off the Coast of Ceylon, where a python effected its "footing" on a ship lying at anchor. When captured it encircled a water butt on deck, and compressed this so violently that the staves were contracted so as to allow the middle hoops to fall on to the deck!

(*d*) *Striking posture:* The habit of constricting is characteristic of the whole family—boas and pythons alike. The snake, roused to activity by the sight of food, advances towards its prey often with quivering tail, and makes a sudden dash at it with open jaws, which are no sooner closed upon its victim than it throws a coil or two—according to the size of the quarry—round it, holding it as in a vice until its struggles have completely ceased, when it relaxes its embrace and proceeds to swallow it, almost always beginning at the head. Dr. Chalmers Mitchell says: "There appears to be no special attempt to crush the prey, to suffocate it, or to break its bones." I certainly agree that there is no attempt to crush with the intention of breaking bones, and so making the mass more easy to deal with, but if the victim is not suffocated how is it killed? My belief is that the vigour of the embrace is such that the victim's chest is incapable of expansion, and asphyxia results, or what amounts to the same thing the heart cannot beat against the pressure to which it is subjected.

(*e*) *Nocturnal or diurnal:* In spite of its cat-like pupil the python is very much on the alert during the day-time, and very frequently when encountered in its native haunts is

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* Curiosites of Natural History, p. 182.

found in the act of swallowing some animal captured in broad daylight. On the other hand, it is frequently on the move at night, for on many occasions, where it has entered a poultry run, its depredations have been committed under cover of darkness.

(*f*) *Hibernation* The python in all parts of India where there is an attempt at a cold season hibernates, retiring for some months to any convenient retreat, a hollow tree, or hole in a bank. or, in the hills, any natural crypt or cave of convenient size.

In Dibrugarh once I found one in February beneath a log on the banks of the Brahmaputra. It was extremely somnolent. Sometimes one hears of several congregating in the same retreat. In the Pioneer (February 19, 1906) is an account of six pythons being discovered in a cavity in the bank of a stream in Mysore. One after another was seized and dragged out, and all ranged between 10 and 12 feet in length. I have also read of a similar occurrence in the Himalayas, though I cannot now lay my hands on the reference. A python was observed in a cave, and the raconteur with his Gurkha orderlies succeeded in extricating several, three or four, if I can rely on my memory.

It seems to me remarkable that in Southern India the python does not hibernate in the Plains, at least Colonel Dawson tells me it does not in Travancore, and Dr. J. R. Henderson says it does not in Madras in captivity, yet in Bombay, which can lay no better claim to a cold season, a specimen caged in the Bombay Natural History Society's rooms hibernated for some months. Phipson made some very interesting observations on this specimen at this period. Between December 21 and April 13, a period of 113 days, the snake refused food, and remained in a very sluggish, sleepy condition. It was noticed that its temperature fell from 82° F. (which had previously been the normal) to 73°. Two rats eaten on December 21 were retained undigested until February 28, when they were disgorged. On ordinary occasions in the hot weather it had been recorded that a similar meal took about eight days to digest. Desquamation during these months of lowered vitality did not occur, an

interval of nearly seven months elapsing between the sloughing periods, though in the rest of the year this process was observed four times.

(*g*) *Progression:* The progress of a python may be sin gular. All snakes known to me move only by a series of lateral undulations, so that their bodies assume S-shaped curves. The python can also progress with the body extended and perfectly straight. During progress wave-like movements of the ribs can be seen beneath the skin, following one another in quick succession, and reminding one of the action of the legs of a centipede. Progress of this character is very slow, in fact cannot be called anything but a crawl, and the body oscillates slightly from side to side. It also moves by lateral undulations like other snakes but only slowly. The slow and laboured locomotion I believe to be due to the very narrow ventral shields. The extremities of the ribs being inserted into the edges of the ventrals causes these bones to be very much bowed. As a result, the middle two-fourths of the body breadth supports the whole of the massive body weight, leaving one-fourth overlapping each side.

I have been assured by some observers that the python can, when so inclined, move as expeditiously as other snakes. Personally I have never witnessed this.

(*h*) *Hissing:* I have heard captive specimens in the hands of jugglers utter a low sibilant hiss.

(*i*) *Sloughing:* Many observations have been made in various quarters on this function, which appears to depend upon the general state of health and vital activities of the snake. I have already remarked upon the great reduction in temperature observed by Phipson in a python in the Bombay Natural History Society's rooms during the period of hibernation, and, with the vitality reduced to such a low ebb that the snake was incapable of digesting its food, it is not surprising that there was a coincident abeyance in the desquamative process during this period. Specimens in Madras and Travancore desquamated during the whole year, and appear not to have hibernated. In India the python sloughs five or six times annually as will be seen from the following table of records :—

Year of Observation.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	Authority.
1886–87	—	—	27	—	17	—	27	—	—	—	—	—	—	10	—	—	—	Phipson, Journal Bom., N. H. S. II., p. 166
1895–96	—	26	—	—	—	18	—	—	—	19	—	—	—	—	—	—	—	Report, Madras Mus., 1896–97
1896–97	—	12	—	—	2	—	—	—	—	17	—	—	—	—	—	—	—	do.
1897–98	—	6	—	—	—	12	—	—	21	—	—	6	—	—	—	—	—	do.
1900–01	—	—	—	—	—	22	—	—	28	—	—	—	4	—	29	—	—	Trivandrum. Col. Dawson in epistola
1900–01	—	30	—	—	26	—	—	—	—	—	—	—	—	—	—	—	—	do.
1901–02	—	—	—	—	—	—	—	—	—*	—	3	—	1	—	22	—	10	do.
1901–02	—	—	—	—	—	—	—	8	—	2	—	—	21	—	23	—	6	do.
1902–03	—	—	—	—	—	22	—	9	—	17	—	6	—	1	—	2	—	do.
1902–03	—	—	—	—	—	—	14	—	—	26	—	19	—	8	—	9	—	do.
1902–03	—	—	—	—	—	20	—	15	—	—	13	—	16	—	13	—	—	do.
1909–10	19	—	12	—	3	—	24	—	—	—	—	—	2	—	30	—	—	Millard in epistola

* Date uncertain.

Food.—The python, as the following remarks will testify, is practically omnivorous. It feeds on mammals, birds, and reptiles indiscriminately, but seems to prefer mammals of relatively large proportions.

Its courage and power may be estimated by the fact that it has been known to overcome and devour a full-grown leopard (*Felix pardus*), sustaining but trivial injuries in the encounter. Thus Major Begbie related the circumstances leading to the death of a python by coolies, which subsequent dissection showed had eaten a leopard measuring 4 feet 2 inches from nose to rump. The snake was 18 feet long, and except for seven claw cuts appeared to have escaped unhurt.

Encounters with tigers also occur, but in the only instances known to me, the snake had the worst of it. Whether it was the aggressor in these contests it is impossible to know. Mr. Inverarity* after killing a tiger found some 2 feet 3 inches of the tail end of a python in the stomach. Another proof of a similar encounter is through Professor Von Linstow,† who found a tape-worm taken from the intestine of a tiger killed in the United Provinces was of a species known to inhabit the python, which it must previously have eaten.

Many are the records of its having eaten deer. Jerdon ‡ mentions one having eaten a cheetah (*Cervus axis*). Dr. Elmes told me that he saw a hog deer (*C. porcinus*) cut out of a python killed by a neighbour, and the horns he thought must have been fully a foot long. The 18-footer that Mr. Harry had killed on his estate in Assam had swallowed a barking deer (*C. muntjac*), whose horns were 4 inches or more long. Mr. Copeland had a 15-foot snake killed on his estate while I was in Assam, which was proved to have swallowed a hog deer.

The Rev. Castets, S.J., wrote to me of a sambur fawn (*C. unicolcr*) being devoured whilst the dam stood by helpless. Tennent mentions a chevrotain (*Tragulus meminna*) being eaten by one in Ceylon. Colonel Channer recorded one that had killed a langur monkey which lay in its coils at the time

* Vol. X., p. 69.
† The Field, December 21, 1907.
‡ Journ. Bom. N. H. Soc., Vol. XVI., p. 520.

of encounter. The snake proved to be 12 feet 10 inches long. The attendant at Cross's Menagerie in Liverpool told me that one of their pythons got loose, and ate a monkey with the collar and chain that were attached to it, on which account probably it disgorged its meal some two days later. In the Pioneer of July 13, 1907, an 18-foot python killed at Raj Shahi was found to have eaten a jackal (*Canis aureus*).

In the Philosophical Transactions,* a gentleman is reported to have found a snake on an island near Bombay lying dead with the quills of a porcupine (*Hystrix leucura*) sticking out through its ribs. We may assume that the snake was a python, as no other Indian species could swallow such an animal. I have also seen masses of porcupine quills that had passed in the dung of pythons. These softened by the digestive juices had been matted into masses which were hard to unravel, the quills having regained their rigidity after drying.

In the Field of December 21, 1907, Mr. Thwaites relates having seen a python in Ceylon spring at a hare (*Lepus nigricollis*) that was racing by. Ferguson reports an 8-footer at Quilon that had killed a kid.

Birds are frequently preyed upon by this snake. Mr. Thwaites mentions a peacock in the coils of a python in Ceylon, and Colonel Evans knew one in Burma eat a pheasant (*Gennæus lineatus*). One, when I was in Dibrugarh, was killed in the act of swallowing a chicken. Mr. Staunton killed one in Assam that had swallowed three of his ducks, and another made an unwelcome visit to Dr. Elmes's fowl-house, accounting for five ducks, four fowls, and one pigeon of his stock, all of which had been swallowed, giving the snake a beaded appearance. Dr. Elmes shot another which he saw lying in a bhil (lake), and found the following in its stomach :—Two large and two small water rats, and two or three toads. Reptiles sometimes furnish the repast. Mr. Millard records one in the Bombay Natural History Society's rooms swallowing a monitor lizard (*Varanus bengalensis*), a rat, and two frogs in quick succession. In its native jungles

* Vol, XLIII., 1744, p. 271,

it sometimes comes into conflict with other large snakes, for Mr. Donaghey told me that, coming back to camp one day in Burma, his coolies produced two snakes which they said they had discovered fighting, and which they killed. These proved to be a *Python molurus* and a hamadryad (*Naia bungarus*). They reported that the python had closed its jaws on the hamadryad and secured it fast. I saw and examined the two skins. The hamadryad measured 10 feet 3½ inches and the python 7 feet 11 inches. In the former skin, at the junction of the middle and the posterior thirds, was a rent 3½ inches long, corresponding to the python's grasp. It is impossible, of course, to surmise which was the aggressor in the fight, but the python, though smaller, was giving a good account of itself.

The most curious meal that I have had reported to me was a double handful of earthworms, and a handful of the berry called by natives "jaman" (*Eugenia jambolana*). My informant was Mr. J. H. Mitchell, a planter in Assam.

In captivity the python usually eats heartily and frequently, accepting anything that is offered, as the following annual bills of fare will show: Phipson says one in Bombay ate 23 rats, 3 hens, 3 crows, and 1 kestrel. One in Madras * ate 82 jerboas, but would not touch house rats; another ate 59 jerboas, 8 squirrels, and 2 quails; a third accounted for 37 rats, 21 squirrels, and 3 quails. In Travancore one ate a spotted deer and 11 fowls; another 1 nilghai fawn, 1 hare, 1 rabbit, 13 fowls, and 1 pond heron; a third ate 14 fowls and 1 crown pigeon; a fourth 2 dogs, 2 hare wallabies, 2 bandicoots, and 54 fowls; a fifth 4 bandicoots, 19 fowls, and 1 spotted dove; and a sixth 1 hare wallaby, 1 bandicoot, and 15 fowls.†

It not infrequently happens that where two are caged together both strike at the same animal, and begin to swallow from opposite ends till their noses meet, when if one does not relinquish its hold, one gets its jaws over the other and swallows its mate. This happened once in Regent's Park and

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* Kindly communicated to me by Dr. J. R. Henderson.

† For this information I am indebted to Colonel F. W. Dawson.

once in the Bombay Natural History Society's rooms when both struck at the same partridge, and similar occurrences have been reported in other Institutions where snakes are kept.

The young which hatched out in Travancore are reported to have eaten the rats offered to them.

One sometimes hears of human beings being swallowed by pythons, but though I have collected several instances of other large snakes overcoming men, I have no authentic instance of this snake doing so, but it is amply capable of overpowering the strongest man. A young European told me once in Hong Kong that he had witnessed, as a boy, with his brothers a large snake (almost certainly a *molurus*) swallow a Chinese baby on Stone Cutter's Island in the harbour. The mother left the child while engaged in some work, and the boys were afraid to encounter so formidable a snake. Major Sealy of the 4th Gurkhas tells me that a reliable old Gurkha Officer told him that once when officiating at a funeral pyre, a python emerged from the water hard by, seized the corpse, and made off with it.

Usually in captivity live animals have until recently been given to the snakes in various Zoological gardens, but now that it is known that pythons, among other snakes, will accept dead food, the order has changed. The fact that they would eat dead animals was noted fifteen years ago by Ferguson, who says: "They will eat a dead rat, or rabbit, just as readily as a live one." He further states that in these circumstances it makes no attempt to constrict, but proceeds to swallow at once. In Regent's Park for some years now, many of the snakes have been fed entirely on dead animals. Dr. Chalmers Mitchell, who paid special attention to this, says it was not noticed that it made any difference whether the food was freshly killed, warm, or bleeding, or if dead for some time. It was noticed that in many cases the prey was not taken until night, and this was particularly the case when pythons took large animals like goats. He further states that the pythons showed their readiness to feed by special restlessness and activity, often leaving the tanks in which they have been lying previously, and that they are specially alert when they hear movements in the passage behind their cages,

or when the back doors are moved, and in the words of the keeper "they are asking for food."*

In swallowing a small animal the mouth is widely opened, and the jaws fixed beyond the head of the victim, which is easily engulfed. Prior to the actual seizure of the head, the python plays about over it with quivering tongue. It does not slaver over it as is commonly supposed, but the saliva flowing freely under the stimulus of food, wets that part which has been received in the mouth, so that if the victim has been disadvantageously seized, and the snake rejects it to make a second attempt, the part of the quarry previously ingested is coated with saliva.

When the animal is large, the snake seizing the head strives to fix its teeth as far back as possible over the victim, when, having got a firm purchase, the jaws—six in all, and all movable—work alternately over the head, one or more at a time relaxing their hold to be pushed further forward and obtain an extended purchase, while the others retain the hold already gained. The process is sometimes a tardy one, and if so the snake is frequently observed to protrude its windpipe, so that an inch or even two may be seen beyond the mouth, beneath the mass that is engaged within the jaws. This extension of the glottis is, however, not a peculiarity confined to the python, for it has been noticed in several other snakes, colubrines and vipers.

It is popularly supposed that after a large meal the python lies torpid, in a condition of satiety, until digestion has far advanced. I very much doubt if this is the true explanation of the disinclination of the snake to move in such circumstances, a disinclination even greater than it displays at other times. I think it is much more likely that in many cases the snake is so distended that it is afraid to move on account of internal injuries it may receive in the attempt. Undoubtedly, accidents do occur which must end fatally. In the case already referred to where a dead snake was found with the quills of a porcupine it had devoured penetrating its flanks between the ribs, it is probable that the

* Dr. Chalmers Mitchell, P.Z.S., 1907, p. 785, *et seq.*

injuries were received whilst moving before the quills had softened under the influence of the digestive function. A python already referred to, which was killed by Mr. Copeland's coolies in Assam, refused to move from its refuge in the jungle though surrounded by a howling mob of coolies. After some time, the sustained apathy it exhibited stimulated the courage of the men, who advanced by degrees nearer and nearer till they actually probed it with sticks and bamboos, and made the situation so untenable that the snake was forced to bestir itself. In trying to get away the horns of a hog deer, which it had swallowed, penetrated its flanks. It was finally despatched, and measured 15 feet. The horns of the deer were about 7 or 8 inches long. Such accidents are not very uncommon in snakes of all kinds—from overdistension, or from mechanical causes, the beaks of birds, claws of various animals, &c.—and I have collected quite a number of incidents of the kind.

The old traveller's stories of pythons, boas, &c., swallowing stags is not borne out by modern observations. I doubt if a python ever kills any deer with horns it is not capable of swallowing. If it does, then sooner or later it has to relinquish its victim. The old books that led one to believe that the stag was swallowed up to its antlers, which projected from the mouth, and remained *in situ* till the head rotted off certainly misled us. The only way in which the body could be retained and the head rejected would be by a slow decomposition (not a digestive process) separating the head at the neck joint, a process that would probably take several weeks to accomplish, and would exhaust even a python's patience. The body of a stag in such a position would not reach the stomach, and would not be subjected to any digestive action, for the saliva is inert to animal tissues. Further, I doubt whether the lung could fulfil its function satisfactorily, even with the small oxygen requirements of a snake, when subjected to the great and continued pressure of a carcass like a stag's.

The digestive powers of a python depend naturally on its general health. Phipson found that in the hot weather in captivity small creatures like rats and crows were completely

digested in about 8 days. McLeod* mentions a goat with horns being swallowed, that took three weeks to digest.

In a vigorous snake every part of the animal swallowed is completely digested, except epithelial structures, such as hair, feathers, quills, teeth, the beak and claws, the scales of reptiles, the cornea, or, in snakes, the disc before the eye which is the analogue of the eyelids in other animals. If the dung is inspected, these structures will be found massed together, and often retaining in a wonderful degree the relationship occupied in the animal ingested. In sickly snakes, or in those whose vitality is impaired and when hibernation is approaching, bones will be found passed in a more or less imperfectly digested state. In the excrement also may be seen circular spaces which are believed to be casts from the snake's intestine. Similar spaces were observed in the fossilized dung of the old reptilian monsters—*icthyosaurus* and *plesiosaurus*—by Buckland, who remarks upon them in his Bridgewater Treatise.

Mr. Kinnear tells me they are frequently asked by visitors to the Bombay Natural History Society's rooms if pythons reject the horns of deer and stags eaten. I cannot speak positively upon this point, which, however, is one that could easily be demonstrated in any vivarium using goats as victims. I have never heard it suggested that they disgorge the horns, but this is one of the many points touched upon in this paper, about which I feel many of our readers could give more satisfactory information than my limited experience permits me to dilate upon. I believe, however, that the horns like other epithelial appendages are passed intact in the dung.

Though we have shown that the python as a rule feeds well in captivity, sometimes it will refuse food for long periods, and without suffering perceptibly. Ferguson records one that fasted for over a year in the Trivandrum gardens, but changed its skin more than once, and always looked glossy and in perfect health. After this fast it ate a white rat, and later again two more.

* The Voyage of H. M. S. "Alceste,"

Thirst.—It is evidently a thirsty reptile, and, in consequence, probably is often impelled towards water for this reason. The dam in Paris in 1841, after accomplishing her maternal duties and successfully launching forth her brood, drank eagerly, swallowing some two tumblerfuls of water, and the young too were observed to slake their thirsts. In drinking it does not fill the mouth, and throw back the head like birds, nor does it protrude the tongue and lap, but puts its mouth to the water, and imbibes like a mammal, the gulping movements of the throat being plainly visible.

Breeding.—(*a*) *The Sexes:* I know of no difference in the sexes, except that in the male the claw-like terminations of the rudimentary hind limb are relatively larger than in the female. It is not known whether one sex attains to a greater length than the other.

(*b*) *Method of Reproduction:* The python is oviparous, and many brooding dams have been reported upon. In all cases the dam has shown great solicitude for the fate of her eggs.

After deposition the female coils herself around them, and has been observed so in captivity, and in a state of nature. As far as I am aware she appears to be generally alone during this period. I have only once heard of her mate being seen anywhere near her. I have several records of pythons found lying up with eggs in jungle and being killed, and with one exception no mention has been made of another snake being found close at hand. The eggs are laid sometimes more or less in the open, the dam proving rather a conspicuous object to the shikari. Sometimes the female retires into a hole in a tree, beneath a fallen tree, or in a termite's nest, one in the latter situation having been found near Colombo some years ago. Several interesting observations have been made during the period of incubation. The dam's temperature during the event, which happened in Regent's Park in 1881, was recorded several times, and compared with that of a male in an adjoining cage. It was always rather higher being about 1·4° to 3° Fahrenheit in excess of the male.* In this case the female having once settled herself around the eggs

* P. Z. S., 1881, p. 960.

remained there for six weeks without taking food, only leaving the eggs once for a few hours. In Paris, too, in 1841 it was reported that the dam refused food and drink during the whole period which lasted 58 days. Her task accomplished, it was noted that she took little or no notice of the young brood.

(*c*) *Season:* From what is known of the period of gestation, and the season when eggs are deposited, the mating season is in December, January, and February, the coldest months of the year, when we know that the python, at any rate in Northern India, is hibernating. We have already seen the effect on the vitality of the snake during this period, which is reduced to the extent that the body heat is sensibly diminished, and the capability for digestion lost. In the circumstances it is most remarkable that the inclination for sexual indulgence is retained, and yet this conclusion is in perfect agreement with that observed by me in other snakes that hibernate. One must assume that pythons retire in pairs, and that the female is gravid when the term of hibernation is spent. In Paris, 1841, the pair that mated were observed "in copula" several times during the month of January and February, and eggs were deposited in May, *i.e.*, the season when eggs are laid in India. Mr. V. A. Herbert, I.F.S., told me he once encountered two pythons coiled together in the Terai on May 2, which he believed were "in copula," and which he shot. The eggs are deposited in the months of March, April, May, and June in India. A gravid female containing large eggs was killed at Pasyala in Ceylon on August 2, 1918.

(*d*) *Period of Gestation:* Some three or four months elapse from the act of mating to the deposition of the eggs.

(*e*) *Period of Incubation:* Though several pythons have laid eggs in captivity in various Institutions, the eggs have frequently been sterile, or when fertile, for some cause have failed to hatch. In Paris, however, in 1841 the incubation was brought to a successful conclusion, the period being fifty-eight days. The 15 eggs were laid on May 6, and on

July 3 eight hatchlings emerged out of the 9 fertile eggs. (Gunther, Rept. Brit. Ind., p. 330.) I have seen it stated elsewhere on the authority of Dumeril that one hatched on July 3, and eight more during the next four days. Of 57 eggs deposited in Calcutta on April 11, 46 proved fertile, and hatched out between June 5 and 10, *i.e.*, 56 to 61 days later. In the event reported by Mr. D'Abreu, 16 eggs were deposited in 7 hours.

(*f*) *Number of Eggs in a Clutch:* Records from various sources show that from 8 to 107 eggs are deposited at one laying. This python is therefore the most prolific snake known to me.

(*g*) *The Eggs:* The eggs are like goose eggs, but soft shelled, the egg investment when emptied being like white kid. The poles are equally domed, and the eggs in a brood vary somewhat in their dimensions. Mr. D'Abreu reported the measurements of six that were deposited in the Nagpur Museum, as 85 to 95 mm. (3·4 to 3·8 inches) in length, and 56 to 64 mm. (2·2 to 2·5 mm.) in breadth. Sterile eggs of the same clutch were 55 to 78 mm. (2·2 to 3·1 inches) in length and 48 to 64 mm. (1·8 to 2·5 inches) in breadth. Two in the Indian Museum measured by me were 85 mm. (3·4 inches) long and 59 mm. (2 inches) broad. Sixteen eggs extracted from a large prospective dam, and preserved in the Colombo Museum, I found to be 88 to 106 mm. ($3\frac{1}{2}$ to $4\frac{1}{4}$ inches) long, and 54 to 62 mm. ($2\frac{1}{8}$ to $2\frac{1}{2}$ inches) broad. Two of these eggs that I opened contained no trace of an embryo.

The weight of one of the Colombo clutch was just 5 ounces. One of the eggs deposited in Calcutta was $5\frac{1}{2}$ ounces, and Mr. D'Abreu reported that one of his eggs weighed $6\frac{1}{4}$ ounces.

Growth.—(*a*) *Before Hatching:* Mr. D'Abreu on cutting open an egg after deposition found an embryo within, about 3 inches long, with bud-like processes on each side of the cloacal aperture, representing the rudimentary hind limb, and relatively much larger than the indications of these structures in adults. After the eggs had been incubated for

forty-nine days, an embryo was found within measuring 14¼ inches in length. Eggs deposited in Regent's Park were found, after six weeks incubation, to contain embryos about 11 inches long.

(*b*) *Length of Hatchling:* The young that hatched from eggs deposited in Calcutta measured about 2 feet. Other hatchlings from eggs acquired in Travancore were reported to average 2 feet 5 inches. The weight of the Calcutta hatchlings proved to be 4 ounces 2 drachms.

(*c*) *Early Life:* The Travancore brood grew 11 inches in 4 months, and it would appear from this that growth in early life is more rapid than later, for Pollock states that a specimen he had that was 12 feet long when acquired grew about 3 feet in two years.

(*d*) *Maturity:* The youngest sexually mature specimens I know of are those that mated at Nagpur. The female measured 2,590 mm. (8 feet 6 inches), and the male 1,725 mm. (5 feet 8 inches). A dam shot on her eggs in April near Colombo was 11 feet long. The specimen in Regent's Park was 12 feet long when she deposited eggs. After sexual maturity growth continues for many years. In captivity specimens rarely grow longer than 12 feet. A specimen in captivity in Travancore for 12¾ years was only 9½ feet long when it died.

(*e*) *Maximum Length:* It is difficult to say with certainty to what length the python may attain. It seems probable that many of the great lengths given by travellers and sportsmen were guessed at, and the snake not actually measured. The creature is very thick relatively to its length, perhaps three or four times the girth of a Russell's viper of similar length, and five or six times that of a dhaman (*Zaocys mucosus*). If a python's length were judged from its girth, the estimate would grossly exceed the real measurement.

Dr. J. R. Henderson showed me the skin of a python in the Madras Museum in 1917, which measured after death 16 feet, though during life its length had been estimated at 26 feet. I very much suspect that this was the specimen alluded to by Abercromby as 27 feet in length. (Snakes of Ceylon, p. 65.)

Specimens of 18 feet are not very uncommon, as will be seen from the following records, and there is little doubt that it exceeds 20 feet. In the Bombay Natural History Journal* Ferguson records an 18 footer from the Ashambu hills, and Major Begbie† one of a similar length killed near Baksa Duars. Other specimens of like proportions have been recorded by the late D. Ferguson in Ceylon,‡ and in the Pioneer from Rajshai (Rajapur).§ I saw the skin of a specimen of the same length in the possession of Mr. A. M. Harry in Assam. Mr. Prince of the King's Own Shropshire Light Infantry shot a female in the United Provinces in 1906, which measured 18 feet 3 inches. In Land and Water (August 10, 1866 or 1867 ?) one is mentioned from Mussoorie of 18 feet 9 inches. Tennent|| refers to a specimen brought him in Ceylon that taped 19 feet. Another reported of a similar length was encountered by Captain George and Mr. Delmege when shooting in Ceylon. This was captured and brought to Colombo, and exhibited in 1885, when I saw it. Jerdon¶ saw a 19 foot specimen killed in Travancore, and Dr. Elmes told me of one he shot in Assam (N. Lakhimpur District) of the same size. A specimen measuring 19 feet 2 inches in our Society's collection, shot by the late Maharajah of Cooch Behar in Assam, was originally reported in this Journal** as a Malayan python (*P reticulatus*). Captain Percival†† says he saw one in Ceylon 22 feet long, and the specimen mentioned by John Ray, and stated by him to be in the Leyden Museum was, he states, 25 feet (I have not been able to get confirmation of this from Leyden, but notice that Dumeril and Bibron refer to one in that Institution 20 feet). Elliot‡‡

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* Vol. X., p. 69.

† Vol. XVII., p. 1021.

‡ Rept. Funna, Ceylon, p. 22.

§ July 3, 1907.

|| Nat. His. of Ceylon, II., p. 153.

¶ Journ. Ass. Soc., Bengal, XXII., p. 526.

** Rept. Brit. Ass., 1877, Trans., p. 115.

†† The Island of Ceylon, 1805, p. 311.

‡‡ Vol. XIII., p. 718.

claims that it grows to a length of 30 feet, and if this opinion were confirmed I think India could lay claim to the two largest species of the genus, for *reticulatus* is also reported to attain to a length of 30 feet. Within quite recent times (1905) a specimen of the latter in the possession of Mr. John Hagenbeck was, as far as could be ascertained, in life 28 feet. The African species *sebæ* is also a very large reptile which is recorded up to 23 feet.

The weight of a python is remarkable, the specimen of *molurus* killed by the Maharajah of Cooch Behar, which measured over 19 feet, scaled 200 pounds (over 14 stone). Mr. John Hagenbeck's reticulated python just alluded to weighed 250 pounds.

(*f*) *Longevity:* Very few records have been made on this interesting matter. Gunther, however, mentions a python attaining the age of 19 years in Regent's Park. It was four years old when acquired, and lived a further period of fifteen years in captivity.

Parasites.—(*a*) *Ectozoa:* Ticks frequently infest the python, fixing themselves into the skin between the scales. *Aponomma gervaisi* is the commonest of these.

(*b*) *Entozoa:* (1) A cestode or tapeworm (*Bothridium pythonis*) may be found in great numbers in the intestine (duodenum). They are sometimes free, sometimes attached to the mucous membrane. Shipley found these in a specimen from Neligatta, Ceylon.

(2) A cestode (*Solenophorus megacephalus*) also inhabits the intestine. Von Linstow found this once in the intestine of a tiger proving that it had recently devoured a python.

(3) A nematode or round worm (*Ascaris attenuata*) was found by Von Linstow in the intestine of this python.

(4) A nematode dubiously referred by Shipley to *Ascaris rubicunda* was taken from the lung of a Ceylon specimen.

(5) A linguatulid (*Porocephalus moniliformis*) was found by Shipley in the lung of a Ceylon python. It has 28 to 30 annuli on the body.

Another species (*P. armillatus*) with 22 rings has been found in two African pythons, viz., *regius* and *sebæ*. The adult parasites infest these snakes taking up their habitat in the lung. Ova are discharged, and probably infect the food or drinking water of the intermediary hosts (man, tiger, leopard, giraffe, mandrill, aardwolf, and hedgehog). The ova hatch inside these animals, reach their larval stage only, and become encysted in the liver, mesentery, and lungs. When an intermediary host is eaten—there may be many more than those enumerated above—the larval form reaches its furthest development, taking up its habitat in the lung of the snake, and the cycle of development is repeated. (Fig. 15.)

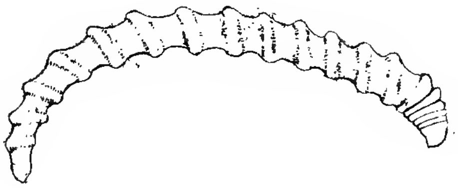

FIG. 15.—Porocephalus armillatus.
(Life size.) (After Sambon.)

These intestinal parasites are most detrimental to the health of their hosts, and in some cases cause death. Ferguson says once all the pythons in one of the cages in the Trivandrum gardens died, and on post-mortem examination they were found to be infested with nematodes that had perforated the walls of the stomach and intestines.

(*c*) *Hæmatozoa:* Sambon discovered a blood parasite (*Hæmogregarina pococki*) inhabiting the red blood cells of this python.

Lepidosis.—*Rostral :* With two depressions, broader than high, in contact with six shields. *Internasals :* Two. *Præfrontals :* Two ; separated from the frontal by a row of scales. *Frontals :* Two. *Supraoculars :* As long as the frontal. *Parietals :* Replaced by scales. *Nasals :* Large, divided. *Loreals :* Many. *Præoculars :* Two or three. *Postoculars :* Three. *Suboculars :* Many. *Supralabials :* Eleven to thirteen ; the anterior two with depressions ; the 1st and 2nd touching the nasals, one sometimes touching the eye, but in some a complete row of suboculars separates all supralabials from the eye. *Infralabials :* Fifteen to twenty, some of the anterior and posterior with depressions. *Sublinguals :* Absent. (Fig. 16.)

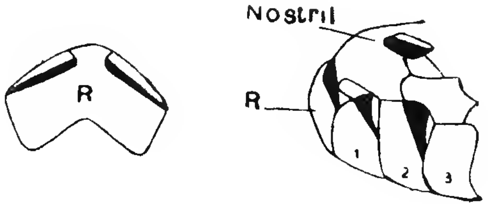

FIG. 16.—Python molurus.

R. The rostral showing pits; 1, 2, the 1st and 2nd supralabials showing pits.

Costals : In midbody. Longer than broad, rectiform, smooth. Vertebrals not enlarged, the breadth of the scales about three-fourths their length, one-third or less than a third the ultimate row. Ultimate and three rows above enlarged, broader than long, progressively increasing in breadth ; the breadth of the scales in the ultimate row nearly twice their length, about half the breadth of the ventrals. In 60 to 75 rows. *Ventrals :* Enlarged, narrow, without keels, 242 to 265

in number. *Anal :* Entire ; as broad as last ventrals. *Subcaudals :* 60 to 72 ; divided. (Fig. 17.)

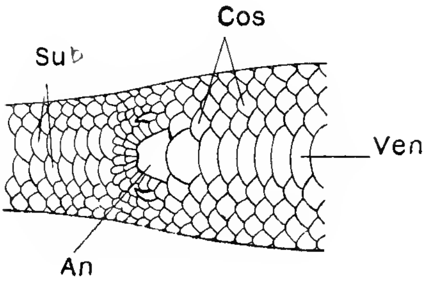

FIG. 17.—Anal region of Python molurus.

Dentition.—From two skulls in my collection. *Præmaxillary:* 4, well-developed. *Maxillary :* 18 to 19 ; anododont, syncranterian, strongly scaphiodont. *Palatine :* 6 ; anododont, scaphiodont. *Pterygoid :* 8 to 10 ; anododont, scaphiodont. *Mandibular :* 16 to 19 ; anododont, strongly scaphiodont. (Fig. 18.)

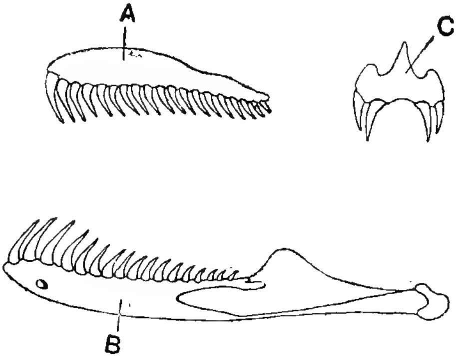

FIG. 18.—Python molurus.
A. Maxilla.
B. Mandible.
C. Præmaxilla.

Distribution.—(*a*) *General:* Ceylon, and Peninsula India to the Himalayas. Eastwards through Assam, Burma, Indo-China, and South China. Westwards through the Punjab and Sind to the borders of Baluchistan.*

(*b*) *Local:* It is a denizen of the plains, but ascends into hills, on rare occasions I believe up to about 6,000 feet.

Sub-family **Boinæ.**

Lepidosis (for Indian Species).—*Rostral:* Broader than high, with or without a transverse ridge; in contact with six shields. Only small scales on the crown. *Internasals:* A modified pair present in some. *Nasals:* Two. *Supralabials:* Ten to fourteen, not pitted; 1st and 2nd touch the nasals, none touch the eye, being separated from it by one to three rows of scales. *Sublinguals:* None. A mental groove in some species.

Costals: At midbody. As long as broad, rectiform, smooth, or more or less strongly keeled. Vertebrals not enlarged, the breadth of the scales subequal to their length, and about half that of the ultimate row. Ultimate row, and two or three above it smooth, broader than long, progressively increasing in breadth. Breadth of scales in the ultimate row about one and a half times their length, and half or less than half the breadth of the ventrals. In 36 to 65 rows. *Ventrals:* Enlarged, narrow, not ridged, numbering from 162 to 210, the last two or three trifid. *Anal:* Trifid, as broad as the ventrals. *Subcaudals:* Entire, numbering 15 to 53.

Dentition.—*Præmaxillary:* None. *Maxillary:* 9 to 17, syncranterian, scaphiodont. *Palatine:* 3 to 6; scaphiodont. *Pterygoid:* 3 to 15; scaphiodont. *Mandibular:* 11 to 20; scaphiodont.

Not represented in Ceylon.

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* In answer to my queries Mr. Cumming tells me the specimen in the Quetta Museum was killed in the Habb River between Sind and Baluchistan.

Family **XENOPELTIDÆ.**

Distribution.—Burma, Indo-China, Malay Peninsula, and Archipelago as far East as Java.

Represented by a single genus which contains but one species.

Not found in Ceylon.

Family **COLUBRIDÆ.**

(Named from the type genus *Coluber.*)

General Characters.—Head small or moderate, narrow, moderate or broad. Snout short, moderate, or long, with or without canthus, pointed, narrowly or broadly obtuse. Eye small, moderate, or large, with round vertical or horizontal pupil. Nostril small, moderate, or large ; open or valvular ; lateral or superior. Neck not, slightly, or markedly constricted. Body cylindrical, compressed or depressed, slender, moderate, or robust. Belly rounded, angulate, or keeled. Tail short, moderate, or long ; cylindrical, slightly or highly compressed.

Habits.—Terrestrial, arboreal, subaquatic, fluviatile, lacustrine, or marine. Active.

Food.—Mammals, birds, reptiles, batrachians, fishes; avine, reptilian, and batrachian eggs; worms.

Breeding.—Oviparous or viviparous.

Poison.—The majority are not poisonous, many are poisonous, and of these some very fatal to man.

Lepidosis.—The head is covered with large shields of a form and disposition peculiar to the family, except in *Chersydrus.*

Costals : Longer than broad, except in *Chersydrus*, keeled or smooth, with or without apical pits or facets, emarginate apically or not ; imbricate or juxtaposed. Arranged in from 13 to 47 rows at midbody. *Ventrals:* Narrow or broad, rounded or keeled. *Anal:* Entire or divided. *Subcaudals :* Entire or divided.

Dentition.—*Maxilla :* Aglyphous, opisthoglyphous, or proteroglyphous ; syncranterian or diacranterian ; isodont or anisodont ; anododont, oinododont, or dinododont ; coryphodont, kumatodont, or scaphiodont. *Palatine :* Dentulous and variable. *Pterygoid :* Dentulous and variable. *Mandibular :* Dentulous and variable.

Distribution.—Over the whole world, except the Arctic regions and snow-clad Alpine tracts.

The family is divided into three series—

(A) **Aglypha.**—Maxilla without grooved or canaliculate fangs.

(B) **Opisthoglypha.**—Maxilla with a pair of grooved fangs at the posterior extremity.

(C) **Proteroglypha.**—Maxilla with a pair of canaliculate fangs at the anterior extremity.

SYNOPSIS OF THE CHIEF CHARACTERS IN LEPIDOSIS OF SPECIES OF THE FAMILY COLUBRIDÆ.

Costals.													
Two heads-lengths behind head.	Midbody.	Two heads-lengths before Vent.	Ventrals.	Anal.	Subcaudals.	Vertebrals enlarged.	Subcaudals entire.	Internasals.	Loreals.	Præoculars.	Labials.	Labials touching eye.	
13	13	13	200 to 243	2	65 to 88	No	No	2	1	1	6–8	3rd & 4th	Dryocalamus nympha
13	13	13	228 to 266	2	24 to 35	No	No	2	0	1	7	3rd & 4th	Callophis trimaculatus
13	13	9?	175	2	129	Yes	No	2	0	1	9?	5th & 6th?	Dendrophis effrenis
13	13	9	149 to 161	2	119 to 128	Yes	No	2	1	1	8–9	4th & 5th or 5th & 6th	Dendrophis caudolineolatus
15	15	11 or 9	154 to 176	2	144 to 161	Yes	No	2	2	1	9	5th & 6th	Dendrophis bifrenalis
15	15	11 or 9	163 to 205	2	110 to 150	Yes	No	2	1	1	8–9	4th & 5th or 5th & 6th	Dendrelaphis tristis
15	15	13 or 11	168 to 206	2	127 to 174	Yes	No	2	0	1	8	4th & 5th	Dryophis mycterizans
15	15	13 or 11	180 to 212	2	146 to 207	Yes	No	2	0	1	8	4th & 5th	Dryophis pulverulentus
15	15	15	120 to 151	1	11 to 26	No	Yes	1	0	1	6	4th	Aspidura trachyprocta
15	15	15	112 to 135	1	18 to 26	No	No	1	0	0	6	4th	Aspidura drummondhayi
15	15	15	199 to 243	1 (2)	75 to 87	No	No	2	1	1	7	3rd & 4th	Dryocalamus gracilis
15	15	15	126 to 163	2	53 to 76	No	No	2	0	1–2	7	3rd & 4th	Ablabes calamaria
15	15	15	158 to 218	2	34 to 56	No	No	2	1	1	7	3rd & 4th	Oligodon subgriseus
15	15	15	135 to 152	2	28 to 31	No	No	2	1	1	7	3rd & 4th	Oligodon templetoni
15	15	15	130 to 160	2	23 to 36	No	No	2	1	1	7	3rd & 4th	Oligodon sublineatus
15	15	15	219 to 236	1	32 to 40	Yes	Yes	2	0	1	7	3rd & 4th	Bungarus ceylonicus
15	15	15	195 to 225	1	37 to 56	Yes	Yes	2	0	1	7	3rd & 4th	Bungarus cæruleus
17	17	14 or 12	180 to 213	2	95 to 146	Yes	No	2	3–5	1	8	4th & 5th	Zaocys mucosus
17	17	13	200 to 238	2	97 to 144	No	No	2	1	1	9–10	4th, 5th, & 6th or 5th & 6th	Chrysopelea ornata

17	17	15	145 to 154	2	30 to 34	No	No	1	1	1	8	4th	Gerardia prevostiana
17	17	15	167 to 202	2	41 to 59	No	No	2	1	1	7	3rd & 4th	Oligodon arnensis
17	17	15	144 to 189	2	34 to 66	No	No	2	1	1	7–8	3rd, 4th, & 5th	Lycodon striatus
17	17	15	170 to 224	2	56 to 80	No	No	2	1	1	9	3rd, 4th, & 5th	Lycodon aulicus
17	17	17	151 to 214	2	42 to 76	No	No	2	1	1	9–10	4th, 5th, & 6th or 5th & 6th	Polyodontophis subpunctatus
17	17	17	123 to 150	1	20 to 35	No	Yes	1	0	0	6	4th	Aspidura copei
17	17	17	101 to 127	1	19 to 27	No	Yes	1	0	1	6	4th	Aspidura guentheri
17	17	17	139 to 155	1	27 to 38	No	Yes	1	0	1	6	4th	Aspidura brachyorrhus
17	17	17	177 to 217	1	37 to 56	No	Yes	2	0	1	7	4th or 3rd & 4th	Haplocercus ceylonensis
17	19	17	188 to 198	1	51 to 64	No	Yes	2	1	1	9	3rd, 4th, & 5th	Cercaspis carinatus
19	19	15·13	214 to 220	1	98 to 100	Yes	No	2	1	1	8	4th & 5th	Dipsadomorphus barnesi
19	19	15·13	209 to 243	1	91 to 112	Yes	No	2	1	1	8–9	3rd, 4th, & 5th or 4th, 5th, & 6th	Dipsadomorphus ceylonensis
19	19	15·13	248 to 266	1	111 to 129	Yes	No	2	1	1	8–9	3rd, 4th, & 5th or 4th, 5th, & 6th	Dipsadomorphus beddomei
19	19	17	129 to 157	2	55 to 85	No	No	1	1	1	8–9	3rd & 4th or 4th & 5th	Helicops schistosus
19	19	17	125 to 152	2	64 to 95	No	No	2	1	1	9	4th & 5th	Nerodia piscator
19	19	17	120 to 161	2	46 to 89	No	No	2	1	1	7–8	3rd & 4th or 3rd, 4th, & 5th	Amphiesma stolata
19	19	17	131 to 141	2	48 to 54	No	No	2	1	2	8	4th & 5th	Amphiesma ceylonensis
21	21	15	206 to 256	1	75 to 96	Yes	No	2	1	1	8	3rd, 4th, & 5th	Dipsadomorphus trigonatus
21–23	23	17	191 to 232	2	73 to 92	No	No	2	1	1	8	4th & 5th	Zamenis fasciolatus
—	25–23	15	163 to 213	1	52 to 75	No	No	2	0	1	7	3rd & 4th	Naia tripudians
27 to 23	29 to 23	21 to 19	220 to 265	1	74 to 96	No	No	2	1	1	9–11	5th & 6th or 4th, 5th, & 6th	Coluber helena
25	27 to 25	17	254 to 270	1	103 to 131	Yes	No	2	1	1	8–11	3rd, 4th, & 5th or 4th, 5th, & 6th	Dipsadomorphus forsteni
25 to 21	25 to 21	19 to 15	132 to 160	2	49 to 72	No	No	2	1	1	9–10	None	Cerberus rhynchops
27	27 to 21	21 to 17	144 to 163	2	34 to 50	No	No	2	1	1	7	3rd & 4th	Macropisthodon plumbicolor
100	150	75	—	—	—	No	No	0	0	0	—	None	Chersydrus granulatus

Series *AGLYPHA*.

Sub-family 1.—**Acrochordiinæ.**

(Named from the type genus *Acrochordus*.)

General Characters (for Ceylon Species).—Head moderate in size. Snout short, without canthus. Eye small, with vertically elliptic pupil. Nostrils superior, lying close together on the front of the snout. Neck not constricted. Body heavy, compressed; very harsh to the touch on account of its rasp-like keels. Belly with a median ridge. Tail short, compressed, and prehensile.

Identification.—Known by its very numerous scales (about 150 at midbody) which are broader than long, and juxtaposed; and the superior, annular, closely-approximated nostrils.

Habits.—Aquatic. Active.

Food.—Fish.

Breeding.—Viviparous.

Poison.—Non-poisonous.

Lepidosis.—As detailed under the species (q. v.)

Dentition.—As detailed under the genus (q. v.)

Distribution.—Coasts from north of Bombay to New Guinea.

The Sub-family contains five genera, two of which are represented in India, and one only in Ceylon.

Genus CHERSYDRUS.

(Greek "chersos" dry land, and "hudor" water; apparently christened under the belief that it is amphibious in habit.)

General Characters.—Body heavy, compressed, attenuating anteriorly and posteriorly. Skin loose, harsh, and rasp-like. A raised ridge along the belly. Head moderate, depressed. Tail compressed. Eye small, inclined somewhat upwards; pupil vertically elliptic. Nostrils large, round, closely approximated on the top of the snout, resembling the mouths of a double-barrelled gun.

Identification.—The costal scales small, juxtaposed, broader than long, and exceeding one hundred at midbody will sufficiently indicate the genus.

Habits.—Entirely marine.

Lepidosis.—Costals broader than long, small, numerous, and juxtaposed; with claw-like keels; larger dorsally than ventrally. Ventrals longer than broad, curved, imbricate, in four or five series along a raised ridge. Head covered with granular scales, and no enlarged shields.

Dentition.—*Maxillary:* Anododont and feebly kumatodont. *Palatine:* Anododont and scaphiodont. *Pterygoid:* Anododont and scaphiodont. *Mandibular:* Anododont and feebly kumatodont.

Distribution.—The genus includes but one species which inhabits the coasts from Bombay to Indo-China, and the Malayan Archipelago to New Guinea.

CHERSYDRUS GRANULATUS Schneider.

(Latin: Adjectival form of "granus" grain, and "ulus" diminutive, in allusion to the small scales.)

The Chersydrus or Rasp-Skinned Water Snake.

History.—First referred to by Schneider in 1799.

Synonymy.—*Hydrus granulatus, Acrochordus fasciatus, A. granulatus, Pelamis granulatus, Potamophis fasciata, Chersydrus fasciatus.*

General Characters.—As indicated under the genus.

Identification.—So different from all other snakes as to be unmistakable. The small scales with harsh chaffy keels, the median ventral ridge formed of four or five transverse rows of scales, and the ring-like closely approximated nostrils are all peculiar to this snake. The top of the head has no enlarged shields.

Colouration.—Alternately banded with deep brown, and pale buff rings which are subequal at midcosta. The dark rings are confluent vertebrally. In the young these bands are very strongly contrasted and conspicuous, and the dark bands black, so that the young snake bears a very zebra-like appearance. There are also light, symmetrically-arranged, small spots on the back of the head, and a larger spot on the temporal region. As age advances the yellow bands become more and more obscure. Many old specimens are uniform, or nearly uniform deep brown.

Habits.—(*a*) *Haunts:* This is a marine snake that clings to the coasts, and travels some distance up tidal rivers. Gunther says: "It is sometimes seen three or four miles from the shore."

(*b*) *Disposition:* Mr. Prater tells me it is a very inoffensive snake. The fishermen about Bombay handle it with impunity. It merely twists about to disengage itself when grasped, and does not attempt to bite them.

(*c*) *Progression:* Its movements in water are active and nimble. On land any progress is very laboured and slow.

Food.—I have only found the remains of fish in its stomach.

Breeding.—(*a*) *Method of Reproduction:* It is viviparous in habit. Cantor had a gravid female containing embryos, Dr. Henderson obtained one with embryos, and I have had another.

(*b*) *Season:* A specimen killed at Bombay in May contained sacs with embryos about 3 to 4 inches long. Dr. Henderson's specimen killed on August 19th contained embryos apparently fit for discharge.

(*c*) *Period of Gestation:* Not known.

(*d*) *The Brood:* My Bombay specimen contained four sacs, Cantor's gravid female contained six, and Dr. Henderson's specimen twelve.

Growth.—(*a*) *Length of Young:* Four of the young extracted by me from Dr. Henderson's specimen measured respectively 325, 330, 337, and 344 mm. ($12\frac{3}{4}$, 13, $13\frac{1}{2}$, and $13\frac{3}{4}$ inches). As none of the young males had their genitals protruding, it is fairly certain their birthday would have been very soon.

(*b*) *Maturity.* My gravid example measured 743 mm. (2 feet $5\frac{1}{4}$ inches). If this species grows at the same rate as other snakes, *i.e.*, doubles its length in the first year of life, this specimen would have been very little over one year old.

(*c*) *Maximum Length:* It grows to 1620 mm. (4 feet). Dr. Henderson's gravid female was exactly this length.

Lepidosis.—(*a*) *Typical:* The costals are very numerous. In one specimen of mine they numbered 98 two heads-lengths behind the head. 154 at midbody, and 71 two heads-lengths

before the vent. The scales are broader than long, juxtaposed, and bear curiously modified chaffy keels. They are broader dorsally than ventrally. The keels occupy the median two-fourths of the scale, and are claw-like with the points set backwards. On the lower costal region these keels are surrounded by a circular moat-like sulcus. The ventrals are longer than broad, very narrow, more or less curved, and imbricate, and in four or five transverse rows on a raised ridge. There are no enlarged head shields, no rostral, and no mental. There is no mental groove, but a furrow filled with small scales. There is an annular nasal, almost entirely occupied by the crater-like open nostril.

Dentition.—From three skulls in my collection. *Maxillary:* 13 to 15. *Palatine:* 7 to 8. *Pterygoid:* 6 to 8. *Mandibular:* 14.

Distribution.—The coasts of India from the locality of Bombay on the Malabar side, coasts of Burma, and Indo-China. The islands of the Malay Archipelago as far east as the Philippines, and new Guinea.

Round the coasts of India it is a fairly abundant snake.

Sub-family 2.—**Colubrinæ.**

(Named after the type genus *Coluber.*)

General Characters (for Indian Species).—Head small or moderate in size ; snout short, moderate, or long, with or without indications of a canthus. Eye small, moderate, or large ; with round or vertically elliptic pupil. Nostril lateral ; small to moderate. Neck not, or but moderately, evident. Body cylindrical or compressed ; slender to robust ; short, moderate, or long. Belly rounded, laterally angulate, or keeled. Tail short, moderate, or long.

Identification.—Not possible from external characters alone. Distinguished by the aglyphous character of the maxillary dentition, the absence of spinal teeth, and peculiarities in the postfrontal bone.

Habits.—Terrestrial, arboreal, or semi-aquatic. Alert and active. Oviparous or viviparous.

Food.—Mammals, birds, reptiles, batrachians, fish, worms. Avine, lacertine, ophidian and batrachian eggs.

Poison.—None are poisonous.

Lepidosis.—Head covered with large shields of the Colubrine type.

Loreal : Usually present. *Sublinguals :* Two pairs.

Costals : Longer than broad ; rectiform or some oblique ; smooth or keeled ; with or without apical pits and facets ; emarginate or not. Vertebrals enlarged or not. *Ventrals :* Three, or more than three times the breadth of the last row ; rounded, angulate laterally, or keeled. *Anal :* Entire or divided. *Subcaudals :* Entire or divided.

Dentition.—*Maxilla :* Aglyphous ; syneranterian or diaeranterian ; isodont or anisodont ; anododont, oinododont, or dinododont ; coryphodont, kumatodont, or scaphiodont ; with or without an edentulous space anteriorly. *Palatine :* Isodont or scaphiodont, with or without edentulous spaces anteriorly and posteriorly. *Pterygoid :* Scaphiodont, with or without an edentulous space anteriorly ; an edentulous space posteriorly. *Mandibular :* Anododont, oinododont, or dinododont ; anisodont, kumatodont, or scaphiodont.

Distribution.—Europe, Asia, Africa, America, Australia. Well represented in India and Ceylon.

Genus POLYODONTOPHIS.

(Greek "polus" many, "odous" tooth, and "ophis" snake.)

General Characters.—The species are small snakes, rarely reaching 610 mm. (2 feet) in length, with the exception of *collaris*, which grows another half foot. The head is about as broad as the body, the snout short, without canthus, and broadly rounded. A neck is hardly evident. The eye is rather small, and the pupil round. The body is rather long, cylindrical, and smooth. The belly is rounded. The tail is short, being about one-third to one-fourth the total length.

Habits.—They are diurnal in habit, and terrestrial.

Poison.—Non-poisonous.

Lepidosis.—There is nothing very distinctive to make the recognition of the genus easy. The head shields are typical of the Family. Rostro-nasal sutures about twice the rostro-labial. The suture between the internasals about

three-fourths that between the præfrontals, and three-fifths to three-fourths the internaso-præfrontals. The suture between the præfrontals about three-fourths, to subequal to the præfronto-frontal. Fronto-supraocular sutures twice or nearly twice the fronto-parietals. *Supraoculars* nearly as long as the frontal, and half to three-fourths the breadth of the frontal along a line connecting the centres of the eyes. *Nasals:* Two. *Loreal:* About half the length of the nasals. Three supralabials touch the eye.

Costals: Longer than broad, rectiform, smooth, and without apical pits or facets. Vertebral row not enlarged. Ultimate row enlarged, and the scales as long as broad. Rows 17 to 19, remaining the same in the whole body length. *Ventrals:* Rounded. *Anal:* Divided. *Subcaudals:* Divided. The supracaudal rows are in even numbers.

Distribution.—Most of the ten species are Asian. Two are American, two Madagascarian, and one peculiar to the Comoro Islands. Of the five Asian species, four belong to the Indo-Malay fauna, and one is Indian. This last, viz., *subpunctatus*, occurs in Ceylon.

Dentition.—The teeth in all the jaws are very numerous, and extremely small. *Maxillary:* 30 to 50 isodont, and syncranterian; *Palatine, pterygoid,* and *mandibular:* Isodont and anododont. The teeth in the species of this genus are peculiar. In most snakes teeth are being continually shed, and replaced, and at any given time if the jaws are dissected out, every alternate tooth will be found to be loose. In consequence, it is almost impossible to prepare any of the jaws with a perfect set. In this genus, on the contrary, practically all the teeth at any given time are found firmly ankylosed, and it is easy to prepare an almost perfect set in spite of their number and small size. Further, with very rare exceptions, snake's teeth, whether moderately or strongly compressed, end in a needle, or dagger point. In *Polyodontophis* the teeth are moderately compressed, and end in a sharp edge somewhat like a chisel, only it is rounded instead of being straight. The edge is parallel to the jaw. A third distinction lies in the curious fact that the chisel-edge is always discoloured, being tinctured brownish.

The mandible in this genus is also peculiar, the posterior two-thirds of the dentary bone being loose, instead of forming a synarthrosis with the articular bone. This is a condition I have not seen in any other snake in the family *Colubridæ*, and resembles that seen in only one other family, viz., *Xenopeltidæ*.

Distribution.—Madagascar and Comoro Islands, South Eastern Asia, Central America. There are ten species, of which four are Indian, and of these one only occurs in Ceylon, viz., *subpunctatus*.

POLYODONTOPHIS SUBPUNCTATUS Dumeril and Bibron.

Jerdon's Polyodont.

(Latin "sub" beneath, and "punctatus" literally pricked; refers to the small spots on the belly.)

Synonymy.—*Calamaria sagittaria, Oligodon subpunctatus, O. spinæpunctatus, Enicognathus melanocephalus, E. humberti, Ablabes humberti, Rhadinea melanocephala.*

History.—First referred to, and figured by Seba in 1734 (Vol. I., Plate XI.). Not referred to again until 1853, when Jerdon described it under the name *Calamaria sagittaria.* (Journal of the Asiatic Society of Bengal, Vol. XXII., p. 528), confusing it with Cantor's species of that name. Re-christened by Dumeril and Bibron in 1854, whose name now stands.

General Characters.—A small species hardly 18 inches in length. Head about as broad as the body. Snout moderate in length, with a slightly-indicated, and obtusely-rounded canthus. Eye moderate, with round pupil. Nostril, small. Neck scarcely apparent. Body moderate in length, cylindrical, and of even calibre throughout. Belly rounded. Tail rather short, being about one-fourth the total length.

Identification.—It is the only Ceylon snake with the costals in 17 rows in the whole body length, with a divided anal shield, and divided subcaudals. The ten supralabials, with the last deepest and longest, is also very distinctive.

Colouration.—Dorsally grayish or fawn-coloured. Each scale is powdered with dark brown. Sometimes dark basal

patches are seen in the forebody, and the powdering is heavier and more evenly distributed posteriorly. An irregular series of black, sometimes light-edged, spots passes down the spine. A more or less conspicuous series of black dots is present on each scale of the fourth row above the ventrals, and often on the lowest row also. The belly is whitish, sometimes with a tinge of green, and bears a regular series of lateral dark dots, one on each ventral. The head is black with usually the canthus, the lips, and a bar between the eyes yellowish (white in spirit specimens). The nape has a conspicuous, broad, well-defined, black band bordered anteriorly, and posteriorly with yellow, which is connected on the median line with the black on the head. A narrow black line borders the yellow of the neck band posteriorly. I have seen specimens without the yellow on the canthus and between the eye, and without vertebral spots.

Habits.—Nothing special has been remarked upon.

Food.—I found a skink in the stomach of one example.

Breeding.—(*a*) *The Sexes:* The male clasper is not bifid. It is a cylindrical organ beset with recurved claw-like processes, many at the extremity being specially large.

(*b*) *Method of Reproduction:* Not known, but I found eggs of such a size and character as to make it probable that it is an oviparous snake.

(*c*) *Season:* Not known.

(*d*) *The Brood:* I have found two eggs in one specimen, and five in another. The largest of these measured 19 by 7 mm. ($\frac{3}{4}$ by $\frac{1}{4}$ of an inch) with no trace of an embryo.

Growth.—(*a*) *The Young:* The length of the young is not known.

(*b*) *Early Life:* My notes throw no light on the annual growth.

(*c*) *Maturity:* The smallest gravid female I have seen measured 324 mm. (12$\frac{3}{4}$ inches).

(*d*) *Maximum Length:* Boulenger records one 440 mm. (1 foot 5$\frac{3}{8}$ inches), and I have seen nothing larger.

Parasites.—(*a*) *Ectozoa:* I found one infested with little mites which appear to be the same as those found by me on *Oligodon sublineatus* (q. v.). I give a figure of one of these

as seen under the microscope. They were attached to the skin between the ventral shields. (Fig. 19.)

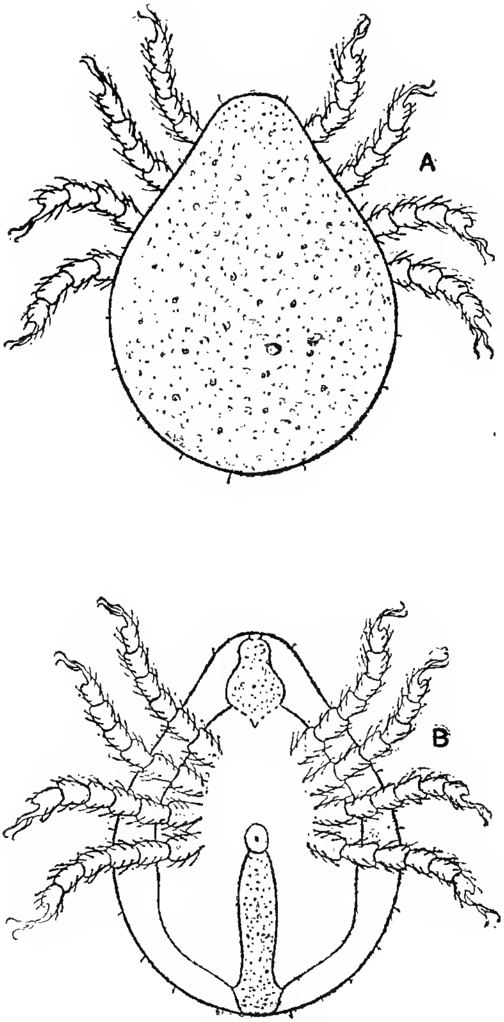

FIG. 19.—Microtrombidrum Mite from Polyodontophis Subpunctatus. (Magnified about 80 diameters.)

Lepidosis.—(*a*) *Typical—Rostral :* Touches six shields; the rostro-nasal sutures longer than the rostro-internasal or rostro-labial. *Internasals :* A pair; the suture between them rather shorter than that between the præfrontals, half to three-fifths the internaso-præfrontals. *Præfrontals :* A pair; the suture between them shorter than the præfronto-frontal; touching the postnasal, loreal, præocular, and supraocular. *Frontal :* Touches six shields; the fronto-supraocular sutures nearly twice the fronto-parietals. *Supraoculars :* Three-fourths the length of the frontal; three-fifths its breadth along a line connecting the centres of the eyes. *Parietals :* Touch two postoculars. *Nasals :* Divided. *Loreal :* One; about half the length of the nasals. *Præocular :* One. *Postoculars :* Two. *Temporal*. One; about two-thirds the length of the supraoculars; usually touching both postoculars. *Supralabials :* Ten; the 1st and 2nd touch the nasal, the 4th, 5th, and 6th the eye, and the 7th and 8th the temporal; the 8th not reaching the edge of the lip. *Sublinguals :* Two subequal pairs; the posterior touching the 4th and 5th infralabials. *Infralabials :* Five; the fifth broader than the posterior sublinguals, and about subequal to them in length; in contact with two scales behind.

Costals : Longer than broad; rectiform; smooth; without apical pits or facets. Vertebrals not enlarged; the breadth of the scales about three-fifths their length, and about half the breadth of the ultimate row. Last seven rows enlarging. In the ultimate row the breadth of the scales is subequal to their length. The rows are 17 in the whole body length. *Ventrals :* 151 to 214*; rounded. *Anal :* Divided. *Subcaudals :* 42 to 76; divided.

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* Ceylon specimens give a range of 157 to 176, and subcaudals 52 to 64. Boulenger gives the range of ventrals from 151 to 240, but the highest count for the British Museum as shown by his Catalogue is 214. I think he must have accepted Blanford's record of 240 for a specimen killed in Calcutta, which is no doubt a *sagittarius*, probably specimen No. 7073 in the Indian Museum labelled Bengal, in which I count the ventrals 235, and subcaudals 54.

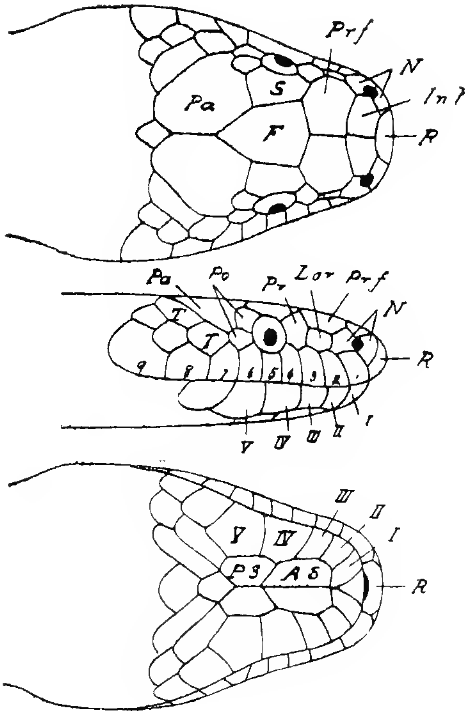

FIG. 20.—Polyodontophis subpunctatus.
(× 2.)

(*b*) *Anomalies*. *Loreal*: I have seen this confluent with the præfrontals. *Supralabials* May be eight, owing to a confluence of shields, in which case the 3rd, 4th, and 5th touch the eye; or nine, with the 4th and 5th touching the eye. In some specimens the 1st infralabials fail to meet behind the mental.

Dentition.—From one skull in my collection.

Maxillary: 44 to 45. *Palatine:* 24. *Pterygoid:* 21 to 22. *Mandibular:* 39 ?

Distribution.—(*a*) *General:* Peninsular India and Ceylon. In India most of the specimens have been collected in hills or their near vicinity.

(*b*) *Local:* Haly says that it is a very common snake round Colombo. This statement is not, however, supported by other observers, nor borne out by the specimens available in museums. It is a denizen of the Low-country. Haly mentions one from Neboda near Kalutara, and Willey one from Puttalam. Mr. Drummond-Hay tells me that it was an uncommon snake at Galatura estate, Ratnapura District (500 to 1,000 feet), and he has not acquired it at higher elevations elsewhere.

Genus TROPIDONOTUS.

(Greek "tropis" a keel, and "notus" the back.)

Boulenger in his catalogue (1893) divides the genus *Tropidonotus* into four Subgenera, *Tropidonotus, Nerodia, Amphiesma*, and *Macropophis*. These are based on differences in the maxillary dentition and lepidosis. His arrangement of this cumbersome genus including over eighty species is as follows:—

TROPIDONOTUS.

Maxillary teeth 18 to 40, posterior longest; mandibular teeth subequal. Head usually distinct from neck; eye rather small, moderate, or large, with round pupil. Body more or less elongate, cylindrical; scales mostly keeled, in some species smooth, usually with apical pits, in 15 to 33 rows; ventrals rounded. Tail moderate or long; subcaudals in two rows. Hypapophyses developed throughout the vertebral column.

Europe; Asia; Africa; North Australia; North and Central America.

Sub-genus Tropidonotus.

Maxillary teeth not more than 30, the hinder gradually enlarged; eyes and nostrils lateral; internasal shields broadly truncate anteriorly.

Sub-genus Nerodia.

Maxillary teeth not more than 30, the hinder gradually enlarged. Eyes rather small, and like the nostrils, directed upwards and outwards; internasal shields usually much narrowed in front.

Sub-genus Amphiesma.

Maxillary teeth not more than 30, last two or three abruptly enlarged.

Sub-genus Macropophis.

Maxillary teeth 35 to 40, posterior but slightly enlarged. Eye very large. Body very slender.

Only two of these divisions, viz., *Nerodia* and *Amphiesma* are represented in Ceylon.

Genus NERODIA.*

(Greek "neros" wet, from the sub-aquatic habit of many of the species.)

General Characters.—" Maxillary teeth not more than 30, the hinder gradually enlarged. Eyes rather small, and like the nostrils, directed upwards and outwards; internasal shields usually much narrowed in front" (Boulenger).

Poison.—Non-poisonous.

Lepidosis.—I notice a feature in the scales of many species allied to these that has escaped the observation of previous herpetologists, and which may considerably assist in the grouping of these closely allied forms. I allude to the apical emargination of the costals. (*Vide* figure 28.)

In the species of *Nerodia* as now constituted, I find the emargination present in *tessellatus* and *xenura* of those known to me, but it is absent in *piscator*, *venningi*, and *punctulatus*.

In all the species known to me the scales are longer than broad, rectiform, and keeled. The vertebral row is not enlarged, the breadth of its scales is about half their length,

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* The differences between *Nerodia*, and *Tropidonotus* are not so marked as those between *Amphiesma* and *Tropidonotus*, so that the claims of *Nerodia* for Generic rank are not so great as *Amphiesma*.

and about half the ultimate row. The ultimate row is enlarged, and the breadth of its scales subequal to their length. The rows are 19 two heads-lengths behind the head (except in *punctulatus*, 17), 19 at midbody, and later reduce to 17 by an absorption of the fourth row above the ventrals (except *punctulatus*, where it reduces to 15).

Dentition.—From the skulls of five species in my collection, viz., *piscator*, *tessellatus*, *xenura*, *venningi*, and *modestus*.

Maxillary: 21 to 29; syncranterian, anododont, coryphodont. *Palatine:* Anododont, isodont. *Pterygoid:* Anododont, isodont, except the last three or four which reduce in size. *Mandibular:* Anododont, isodont, or feebly kumatodont.

Distribution.—Thirteen out of the twenty-four species recognized by Boulenger are American, three (one dubiously) African, seven Asian, and one European.

NERODIA (TROPIDONOTUS) PISCATOR* Schneider.

(Latin "piscator," a fisher.)

The Chequered Keelback.

Tamil: "Tanni pambu" (water snake); *Singhalese:* "Diya polonga" (water snake). (Willey.)

Synonymy.—*Hydrus piscator*, *H. palustris*, *Coluber anastomosatus*, *C. umbratus*, *C. braminus*, *C. mortuarius*, *C. dora*, *C. hippus*, *C. bengalensis*, *C. rectangulus*, *Enhydris piscator*, *Amphiesma flavipunctatum*, *Tropidonotus melanozostus*, *T. mortuarius*, *T. quincunciatus*, *T. umbratus*, *T. tytleri*, *T. flavipunctatus*, *T. striolatus*.

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* Boulenger in his catalogue (Vol. I., p. 232) concedes to this the rank of a species under the name *Tropidonotus asperrimus*, on the grounds that in this form all the costal rows are keeled except the last, whereas in *T. piscator* two or three rows are not keeled. I have examined many hundreds of Indian *piscator*, and find that the number of rows not keeled is variable. I have also examined several of the Ceylon form *asperrimus* most critically, beside the Indian *piscator*, and cannot discover any constant character whereby the two can be separated. *Asperrimus*, however, I consider a distinct colour variety of *piscator* peculiar to Ceylon, an insular form comparable to the Andaman variety *tytleri* of Blyth. To those who follow Boulenger the snake should be called *Tropidonotus asperrimus*.

History.—First referred to and figured by Russell in 1796 (Vol. I., Plates XX., XXVIII., XXXIII., and Vol. II., Plates III., XIV., and XV.). Christened by Schneider in 1799.

General Characters.—A moderate-sized species growing to over 3 feet in length. Head ovate, and snout subacute, with an indistinct obtusely rounded canthus. Neck fairly evident. Eye with a decided inclination upwards, an iris speckled with greenish-gold, and a round pupil. Nostril slit-like, and placed unusually high on the snout, thus approximating to the condition seen in the true fresh-water snakes of the Sub-family *Homalopsinæ*. Body stout and muscular; cylindrical; attenuating slightly towards the neck and posteriorly, and rough from the keeling of the costals. Belly rounded. Tail longish, being more than one-fourth, and approaching one-third the total length.

Identification.—The costals 19 two heads-lengths behind the head, 19 at midbody, and 17 two heads-lengths before the vent, and the rostro-internasal sutures half or less than half the rostro-nasals will serve to identify this among Ceylon snakes.

Colouration.—A variable snake. In Ceylon there are at least three varieties.

(*a*) Variety *flavipunctata* (Gunther): Olive-brown or olive-green dorsally, with one or more lateral series of pale spots.

(*b*) Variety *quincunciata* (Schlegel): Olive-brown or olive-green dorsally, with six series of black spots forming a chequered pattern. These spots are more pronounced anteriorly.

(*c*) Variety *asperrima* (Boulenger): Like the last posteriorly, but with a single series of very large lateral black blotches anteriorly, those of one side more or less confluent with those of the other.

In all the head is olive-brown or olive-green, with two narrow, black, oblique streaks from the eye, the upper longer, passing across the front of the gape, and the lower to the lip on the 5th and 6th supralabial shields. Belly pearly-white, sometimes with a pinkish suffusion laterally. Young are marked like adults, except that they have a small light dot

on each parietal shield near the interparietal suture. Mr. Drummond-Hay tells me that the last variety is much the commonest up-country.

Habits.—(*a*) *Haunts:* It frequents the neighbourhood of water, and abounds in rivers, tanks, paddy fields, and pools, but where the vegetation is rank and damp enough to harbour frogs, it may wander some distance from water, and will occasionally enter the bungalow. Once in Assam a cow that was observed indulging in a giddy frolic was seen to rid herself of a *piscator* that had got on her back!

(*b*) *Disposition:* With the exception of the *Echis*, I think it is the most vicious snake I know. It is ever ready to bite, and strikes with great determination and rapidity, fastening itself with such tenacity that I have known it necessary to prize apart the jaws to disengage its hold. Even hatchlings exhibit this ill-temper, and I have frequently been bitten by them when trying to effect their capture.

(*c*) *Striking Posture:* When encountered at close quarters, it erects the forebody and flattens it cobra-wise to a remarkable extent, and then hurls itself at any offending object, into which it buries its teeth with great malice. Very many cases of snake bite are to be attributed to this species.

(*d*) *Nocturnal or Diurnal:* It is for the most part diurnal in habit, and is frequently to be met with disporting itself in pools or floods, or in the act of swallowing some victim. On the other hand, I have frequently encountered it at night crossing roads, or been attracted to some spot by the piteous and very human cries of some wretched batrachian, only to find a *piscator* in the act of devouring a victim.

(*e*) *Progression:* It is an extremely active snake, that usually strives to elude any threatening danger, in fact, I know of no snake that can compare with it for muscular strength and agility. It is a most remarkable thing that it can actually jump clear off the ground, and will do so repeatedly if pursued. I have heard many jugglers call this "the jumping snake" and give a demonstration of this surprising activity. On several occasions, too, when bicycling or driving, I have seen this snake leap forward to evade the quickly advancing wheels. Even my hatchlings have

demonstrated similar powers. In the water it swims nimbly and with astonishing vigour, in no way inferior to that of the true fresh-water snakes *Homalopsinæ* and the marine snakes *Hydrophiinæ*. During flood time in the low-country it is frequently to be seen swimming on the surface of the water submerged, except for its head, and if hustled it will dive, and disappear with wonderful alacrity.

(*f*) *Æstivation:* During the hot weather it goes into retirement, and while the drought lasts extremely few specimens come to bag, but as soon as the monsoon bursts, and the air is sonorous with the croakings of multitudes of frogs that have suddenly appeared as if by magic, the chequered keelback quits its summer quarters and disseminates itself broadcast.

(*g*) *Hibernation:* In parts of the country that enjoy a cold winter *piscator* disappears, and goes into retirement till the warmth of Spring entices it forth again. Some individuals, however, will be met with, during the warmth of the day sunning themselves. I have encountered them when duck shooting in Northern India lying on the vegetation above the water level.

(*h*) *Sloughing:* A specimen in captivity in the Madras Museum shed its skin on May 17, June 11, 1896 ; January 20 and February 24, 1897. Mr. D'Abreu told me of a specimen in Nagpur that desquamated twice during a confinement of a little over two months. I had a specimen in Rangoon that sloughed on February 2 and March 13 and then died. Another in Cannanore exfoliated on June 19, and again on July 13.

Food.—Its main diet is batrachian, usually frogs being ingested, doubtless because they are so plentiful and so easy to capture. Fish, however, are frequently taken. I have found as many as eight or nine tadpoles in the stomach of a young specimen. Mr. D'Abreu tells me he once found six large toads (*Bufo melanostictus*) and a fish inside one specimen. I knew one swallow four small frogs (*Rana limnocharis*) at one meal. In Cannanore, on several occasions one was brought to me wriggling at the end of a fish hook, which had been baited with a frog by native urchins. I have never seen one attempt to constrict its victim, nor

does it wait till they are dead, but if advantageously seized it commences to swallow at once, so that the frog, when this happens to be the unfortunate, continues to squeal piteously for some time after engulfment. On one occasion only have I found a mammal ingested, and that a mouse.

Breeding.—(*a*) *The Sexes:* Females attain to a greater length than males, and have shorter tails. Blanford describes a pair which he dislodged from beneath a large stone in a stream. They had evidently made their home there, and he remarks that they showed a disinclination to quit the spot. It is remarkable that though they were evidently cohabiting, the female was in an advanced state of egg-bearing. This, with other cases of a similar kind, leads me to think that snakes possess a mutual love and attachment in no way inferior to that exhibited by many warm-blooded animals, which preserve their conjugal relationship long past the term of sexual gratification.

The anal glands in both sexes furnish a yellow secretion like custard, with a penetrating and disagreeable odour.

The male clasper is a subcylindrical organ, not bifid at its summit, and is covered with a multitude of extremely small, recurved claw-like processes from base to extremity. These processes are disposed so closely and are so fine that they give a villose appearance to the surface. A few enlarged processes are grouped together at the extreme base of the organ on its inner and outer faces, and a solitary enlarged process is to be seen on the posterior surface of the organ at about the junction of its lower and middle thirds.

(*b*) *Method of Reproduction:* The chequered keelback is oviparous. I have had many clusters of eggs brought to me, and on two occasions a dam has deposited her ova in my vivarium. The eggs were discharged into the water and sunk in that element, but they are not naturally voided into the water, because after a few hours their contents, by a process of osmosis, mingle with that fluid rendering it milky, and the eggs decompose.

(*c*) *Season:* Father Dreckman informed me of a pair "in copula" at Khandalla in October. I had a pair observed in similar circumstances at Rangoon in January, the female

subsequently discharging eggs in my vivarium. My notes contain records of 27 egg-bound females, with eggs in various stages of development in the months of November to May (November, three in Cannanore ; December, two in Dibrugarh (Assam) ; January, one in Cannanore, one in Rangoon, one in Fyzabad, and three in Dibrugarh; February, one in Rangoon, one in Poona, one in Fyzabad, and three in Dibrugarh ; March, one in Mandalay ; April, eight in Dibrugarh; May, one in Dibrugarh). Mr. D'Abreu has informed me of an egg-bound female at Nagpur in December.

My gravid female deposited eggs in Rangoon in March, and I had clusters of eggs brought to me in January at Cannanore, May in Dibrugarh, and August in Shillong. A clutch was deposited in captivity in February at Madras, I was told by Mr. Thurston, Superintendent of the Museum.

Begbie reported eggs hatching in May at Cawnpore, and I had eggs hatching out in June at Dibrugarh, and in September at Shillong.

I have had hatchlings in March at Cannanore; in May from the Andamans; June in Rangoon, Dibrugarh, and the Nilgiris; July from Fyzabad and the Nilgiri Hills; August in Shillong and the Nilgiris; and September in Shillong.

(*d*) *Period of Gestation :* This is one of the very few snakes whose period of gestation is known. In Rangoon a snake was brought to me on January 3, said to have been found in conjunction with another. I kept this alone in my vivarium, and fifty-five days later, on March 9, fourteen eggs were laid between 9 and 11 A.M. Ten more eggs were discharged between March 9 and 23. I think it probable that the enfeebled health of the parent, consequent upon her incarceration, may have caused this protracted and spasmodic discharge of her ova, for on another occasion a specimen in my vivarium laid all her fifty-seven eggs within a few hours.

(*e*) *Period of Incubation* This is not known. All my attempts to imitate nature and bring the ova to fruition have failed. Where clusters of eggs have been brought to me in a state approaching hatching I have been sometimes successful.

(*f*) *The Eggs:* Those I obtained in Cannanore were all much alike in size, shape, and tension, but those I acquired in Rangoon varied considerably. Some were tense, others flaccid, and they varied much in size, as may be inferred from their weights, which ranged from 1 drachm 28 grains to 2 drachms 37 grains. These variations were probably the result of impoverished health. Normally they are soft and white without gloss. When voided they are evidently surrounded with a glutinous pellicle, for they adhere firmly at any points where chance has placed them in apposition. The poles are isomorphous, the shape elliptical, and tension much like that of a ripe grape. In length they vary from 27 to 40 mm. (1 1/12 to 1 11/20 inches), and in breadth from 18 to 25 mm. (15/20 to 1 inch). They vary in number from 8 to 87. I know of seven instances where they exceeded 50. The greatest number I have had was 75, but Blanford records 85, and Mr. D'Abreu has informed me of a specimen with 87. With the exception of the Python and Russell's viper, this is the most prolific snake I know.

Growth.—(*a*) *Intraoval Life:* From eggs I hatched out in Shillong (Assam) I ascertained that the young grew at the rate of about 75 mm. (3 inches) in twenty-four days.

(*b*) *The Hatchling:* The young snake effects its own liberty by cutting the egg investment by means of the fœtal tooth. The exit apertures are variable in number and extent. In one egg there were six cuts, more or less parallel in direction, the longest over half an inch long. In another there was but one cut, and this only a quarter of an inch in length.

The fœtal tooth is not apparent when the little snake is viewed in profile, as it does not project beyond the rostral, in fact, this shield must be flattened to permit this structure being brought into use. The cutting edge which is horizontal and directed forwards is seen to be bidentate, owing to a shallow, but broad, median emargination.

The eggs I had in Shillong did not all hatch out at once, but one hatched on September 8, three on the 14th, two on the 16th, one on the 17th, and one on the 18th.

The length of the hatchling varies from 170 to 215 mm. ($6\frac{3}{4}$ to $8\frac{1}{2}$ inches).

(*c*) *Early Life:* The growth is somewhat difficult to follow, as the breeding season covers such a long period of the year. The young appear, however, to grow about 10 inches a year, thus they average about 17 to 18 inches in length at the end of the first year, 27 to 28 at the end of the second, and 37 to 38 at the end of the third.

(*d*) *Maturity:* The smallest female in my records, to demonstrate her fertility, measured ·806 mm. (2 feet $7\frac{7}{8}$ inches), and I estimate that she was about two and a half years old. All other gravid females have been at least three years old.

(*e*) *Maximum Length:* I have measurements of some hundreds of specimens, and have only about two records where the length exceeded 1,220 mm. (4 feet), viz., 1,252 mm. (4 feet $1\frac{1}{4}$ inches), and 1,290 mm. (4 feet $2\frac{3}{4}$ inches). Nicholson records one example 1,296 mm. (4 feet 3 inches), and Blanford another of similar length. Mr. D'Abreu has informed me of a specimen killed at Nagpur which taped 1,480 mm. (4 feet $10\frac{1}{4}$ inches).

Parasites.—(*a*) *Entozoa:* The chequered keelback suffers very much from internal parasites. A linguatulid, or maggot-like, white parasite, growing to about 10 mm. ($\frac{3}{8}$ of an inch) in length, frequently attaches itself to the tissues in the abdominal cavity. This is called *Porocephalus crotali*. (Fig. 21.)

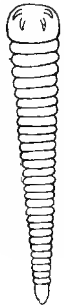

FIG. 21.—Porocephalus crotali (life size) from Nerodia piscator.

Two kinds of nematode worms commonly infest the stomach. One of these is seen in clusters with the cephalic extremity attached to the mucous membrane. Each colony—and there may be several—consists of many individuals of very variable size, some of the largest attaining to a length of 135 mm. (5¼ inches). I believe this is the worm described by Von Linstow as *Kalicephalis willeyi*, but I may be confusing this worm with the next species. The second gastric worm, also common, is smaller than the foregoing, and grows to about 34 mm. (1⅜ inches). I think it is invariably not attached to the coats of the stomach, but free. I believe this is the worm described by Von Linstow as *Heterakis anomala.*

Species of cestodes or tapeworms also infest this snake. I have found many convoluted beneath the mucous membrane of the abdominal cavity and organs, and some of these unravelled reach the length of 250 mm. (10 inches). The lining membrane of the abdominal cavity and its organs are frequently studded with myriads of small, white, ovate bodies, which Professor Shipley pronounced larval forms of a *Pterocercus.* He suggested that these probably reach their final development inside the Serpent Eagles or some other predacious bird or animal that lives upon snakes.

(*b*) *Hæmatozoa:* The red blood cells of the chequered keelback are sometimes invaded by a hæmogregarine, the *Hæmogregarina mirabilis* of Castellani and Willey, which is also found in the erythrocytes of many other snakes. It appears to be somewhat unusual, for its presence was not detected by Dobell in ten specimens submitted to him for examination.

Lepidosis.—(*a*) *Typical—Rostral:* Touches six shields, the rostro-nasal sutures twice, or more than twice, the rostro-internasals. *Internasals:* A pair; the suture between them equal to, or nearly equal to, that between the præfrontal pair; subequal to the internaso-præfrontal. *Præfrontals:* A pair; the suture between them rather longer than the præfronto-frontal; touches the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* Touches six shields; the fronto-supraocular sutures twice, or more than twice, the fronto-parietals. *Supraoculars:* Nearly as long as the

frontal ; about as broad as the frontal along a line connecting the centres of the eyes. *Nasals :* Divided. *Loreal :* One ; about two-thirds the length of the nasals. *Præocular:* One. *Postoculars :* Three. *Temporals :* Two ; the lower about as long as the supraocular. *Supralabials :* Nine ; the 1st and 2nd touch the nasals ; 4th and 5th the eye, and the 7th and 8th the lower temporals. *Sublinguals :* Two pairs; the posterior longer, and in contact with the 5th, 6th, and 7th infralabials. *Infralabials :* Seven ; the 7th about as broad as the posterior sublinguals, but shorter ; in contact with three scales behind. (Fig. 22.)

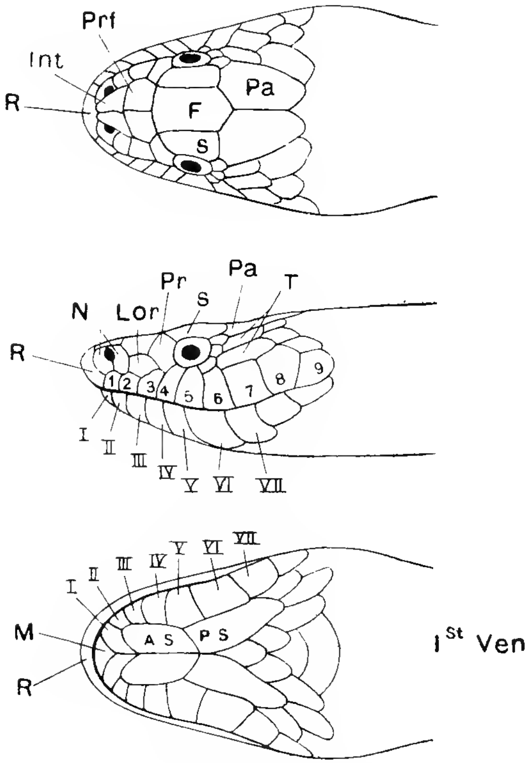

FIG. 22.—Nerodia piscator (life size).

Costals: Longer than broad; rectiform; keeled, except the last one, to three rows; emarginate. Vertebrals about half their length, and half those of the ultimate row. The last two rows are enlarged. Ultimate row broadest; the breadth of its scales about equal to their length. In 19 rows two heads-lengths behind the head, 19 rows at midbody, and 17 two heads-lengths before the vent. The reduction in rows takes place behind midbody, and is due to the absorption of the fourth row from the ventrals. *Ventrals:* Rounded; 125 to 152. *Anal:* Divided. *Supracaudals:* In even rows, keeled till after the fours are established. *Subcaudals:* Divided; 64 to 95.

(*b*) *Anomalies—Internasals:* I have rarely seen one, and as rarely three. *Præfrontals:* I have seen four in a single transverse series, and Mr. Green has told me of a specimen with only one. *Nasals:* I have seen these very rarely meeting behind the rostral. *Postoculars:* Not unusually there are two, or four, or even five. *Supralabials:* Frequently some of the series are confluent. Sometimes only the 4th or only the 5th touches the eye. I have seen ten rarely. *Temporals:* Rarely but one. *Anal:* Very rarely is entire. *Subcaudals:* Occasionally a few may be entire.

Dentition.—From eight skulls in my collection. *Maxillary:* 21 to 26. *Palatine:* 11 to 16. *Pterygoid:* 22 to 33. *Mandibular:* 22 to 27. In my Ceylon skull the *maxillary* are 21 to 22, the *palatine* 11 to 12, the *pterygoid* 22 to 24, and the *mandibular* 22. (Fig. 23.)

FIG. 23.—Mexilla of Nerodia piscator.

Distribution.—(*a*) *General:* Peninsular India to Sind and Baluchistan in the north-west, and Assam in the north-east. Burma, Indo-China, to Southern China and Formosa. The Malay Peninsula and Archipelago as far east as Java. Ceylon and the Andamans Islands.

(*b*) *Local:* Essentially a snake of the plains. It ascends into hills and flourishes at a considerable altitude. I have had it in the Western Himalayas (Bhim Tal) at 4,500 feet, and in the Nilgiris up to 6,300 feet. It is an extremely common snake in India and Ceylon.

Genus AMPHIESMA.*

(Greek "amphiesma" a garment.)

General Characters.—"Maxillary teeth not more than 30, last two or three abruptly enlarged" (Boulenger).

Lepidosis.—I notice that the scales are apically emarginate in ten Asiatic species familiar to me, viz., *platyceps, himalayana*, *ceylonensis*, *beddomei*, *stolata*, *nigrocincta*, *subminiata*, *chrysarga*, *monticola*, and *tigrina*. In all these species the costals are longer than broad, rectiform, and strongly keeled. The vertebral row is not enlarged, the breadth of its scales is half or less than half their length, and half or less than half the breadth of the ultimate row. The ultimate row is enlarged, and the breadth of its scales is subequal to their length. The rows in all are 19 two heads-lengths behind the head, 19 in midbody, and reduce after this to 17 by an absorption of the fourth row above the ventrals.

Dentition.—I have skulls of all the ten species just alluded to, which agree in the following characters. The maxillary teeth have a short gap in the series posteriorly (diacranterian). The præcranterian teeth are isodont and number from 15 to 35. Cranterian 2, much enlarged, ungrooved, and not obliquely-set teeth, two or three times the length of the last prænodal tooth.

Distribution.—Of the twenty-five species referred to by Boulenger, four are Madagascarian, and twenty-one Asian. Two of these, viz., *ceylonensis* and *stolata*, occur in Ceylon.†

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* On the maxillary dentition alone *Amphiesma* has, in my opinion, as good claims to be considered a genus apart from *Tropidonotus*, as *Macropisthodon*, *Pseudoxenodon*, *Helicops*, and *Xenochrophis*, all recognized as distinct genera by Boulenger.

† Abercromby (Snakes of Ceylon, pp. 48 and 63) alludes to *Tropidonotus subminiatus* as occurring in Ceylon. This is a mistake, as *subminiatus* occurs in the Eastern Himalayas, the Hills of Assam, Burma, Indo-China to Southern China, and the Malay Archipelago as far east as Celebes. I cannot suggest what snake he refers to under this title.

AMPHIESMA* CEYLONENSIS Gunther.

(Latin implying an inhabitant of Ceylon.)

The Ceylon Keelback.

Synonymy.—*Tropidonotus chrysargus.*

History.—First referred to by Dr. Gunther in 1858, and considered by him a variety of *T. chrysargus*. Later (1864) given the rank of a species by the same authority.

General Characters.—A small snake, 1½ feet long. Head rather small, snout moderate, somewhat narrowly rounded, with rounded canthus and a fairly evident neck. Eye large. Nostril occupies about the middle two-fourths of the suture between the nasals. Body rather short, cylindrical, fairly robust, and rough from the costal keels. Belly rounded. Tail short, being about one-fifth to one-sixth the total length.

Identification.—Costals in 19 rows two heads-lengths behind the head, 19 at midbody, and 17 two heads-lengths before the vent, and two præoculars will suffice to identify a normal specimen.

Colouration.—Brownish dorsally, with about twenty blackish cross-bars, enclosing large ovate or round, rufous or buff, spots laterally. A series of less perfect and narrower cross-bars occurs in the intervals. Head brownish above, the lips whitish. A conspicuous postocular stripe extends to some distance behind the neck. Belly whitish or yellowish, and immaculate. Tail more or less mottled beneath. The young, according to Boulenger, have a somewhat conspicuous yellow patch on the nape. Abercromby, however, says that the yellow collar markings were absent in the hatchling observed by him. The skin between the scales, I am informed by Mr. Green, is a vivid scarlet, but this is not seen until the snake under excitement dilates itself.

Habits.—Very little known. Mr. Green tells me that a specimen he had in his vivarium was a very gentle snake. When alarmed it expanded its body bringing into view the scarlet colouration of its skin.

Food.—Nothing known.

* See footnote to *Nerodia piscator* (p. 91).

Breeding.—(*a*) *Method of Reproduction:* Abercromby mentions finding two eggs of this snake, so that it is oviparous in habit.

(*b*) *The Egg:* Abercromby gives the measurements of his eggs as 41 mm. long and 12 mm. broad ($1\frac{5}{8}$ inches by $\frac{1}{2}$ inch). He unfortunately gives no date when they were found.

Growth.—(*a*) *The Hatchling:* Abercromby's eggs contained embryos 165 mm. long ($6\frac{1}{2}$ inches), and a dead hatchling was found with them. This is a remarkable length for the young of a species that only grows to about 18 inches.

(*b*) *Maximum Length:* Boulenger gives the measurement as 460 mm. (about 18 inches). The tail 85 mm. ($3\frac{3}{8}$ inches).

Lepidosis.—(*a*) *Typical*. As detailed under the genus. *Præoculars:* Two. *Temporals:* Two; the lower about as long as the supraocular. *Supralabials:* Eight; the 1st and 2nd touch the nasals, 4th and 5th the eye, and the 6th and 7th the lower temporal. *Infralabials*: Six; the 4th, 5th, and 6th touching the posterior sublinguals; 6th broader than the posterior sublinguals, but much shorter, touching three scales behind.

Costals: Keeled, except in the last two or three rows. *Supracaudals:* Keeled till the fours are established. *Ventrals:* 131 to 141. *Anal:* Divided. *Subcaudals:* 48 to 54.

Dentition.—From one skull in my collection. *Maxillary:* Præcranterian 24 to 26; subequal. Cranterian: Two; obliquely set, ungrooved, about twice the length of the preceding. The *palatine* are as large as the *maxillary* and number 20. The *pterygoid* are as large as the *maxillary* and number 30 to 31. The *mandibular* are as large as the *maxillary* and number 32 to 34. (Fig. 24.)

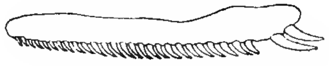

FIG. 24.—Maxilla of Amphiesma ceylonensis.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* It is evidently an uncommon snake, for Ferguson failed to procure a specimen. Haly only refers to three,

Green only acquired one, and the British Museum collection contained only five. The exact localities are in most cases not specified, but Haly mentions one from Balangoda and another from Udugama, and Green's example was from Peradeniya. These records make it appear a hill snake. Mr. Drummond-Hay tells me it is uncommon up-country. He obtained one at Punagalla estate, Yatiyantota district (below 3,000 feet), one from Lennock estate in the centre of the Uva patanas (3,000 to 4,000 feet), and one or two from Balangoda district (about 3,000 feet).

AMPHIESMA STOLATA.

(Latin "stolatus" dressed, signifying decked.)

The Buff-striped Keelback.

Tamil: "nikkattan-kutty," "kaliyan-kutty," and "nikkattan pambu," all implying "the snake that cannot kill" (I am informed by Dr. J. R. Henderson). *Sinhalese:* "ahara kukka*" (Ferguson).

Synonymy.—*Coluber stolatus, C. bilineatus, Elaps bilineatus, Tropidonotus ruficeps.*

General Characters.—It is a graceful little reptile with the body rather short and the tail rather long, viz., about one-fourth the total length of the snake. Anteriorly the body attenuates somewhat to the head, so that the neck is fairly evident, and posteriorly reduces perceptibly in girth to the vent, where, in females especially, a further reduction marks the commencement of the tail. Dorsally the body and tail are rough from the sharply-keeled scales. The head is rather depressed, evenly rounded from the crown to the side of the face, especially over the muzzle, and has the snout moderately narrowed. The eye is large, with a round pupil and an iris flecked with gold, especially at the pupillary margin. The

* Inquiry brings to light the following story from old Ceylon records: It appears that the old Ceylon Kings kept a jester about the Court, and on one occasion, at a garden party, the King came across a snake called "Ahan-kukka" (synonymous with the Pali word for the tame snake "man-balla"), meaning literally "ahan," I am, "kukka," a dog. He called for the jester, and seeking to have some fun at his expense, asked him before his courtiers and assembled guests the name of the snake, but the jester was quickwitted enough to discover the King's intention, and replied untruthfully "ahara kukka," meaning "a dog looking for food," since which the snake has been so known.

nostril is open and occupies about two-fifths of the depth of the suture between the nasal shields, leaving about one-fifth of the suture uninvolved above and about two-fifths below. The tongue is a dull orange colour at the base and has black tips.

Identification.—The costals in 19 rows two heads-lengths behind the head, 19 at midbody, and 17 two heads-lengths before the vent, two internasals, and seven or eight supralabials will distinguish a normal specimen from all other Ceylon snakes.

Colouration.—The ground colour is olivaceous-brown of various depths of intensity, some specimens being dark, others light. A buff stripe beginning in the neck or forebody, at first obscure, but becoming well-defined and conspicuous, passes down each side of the back to the tail tip. These involve one whole and two half rows of scales and are separated from one another by five whole and two half rows. The ground colour is further ornamented with black or blackish, somewhat irregular crossbars, which are always most obvious anteriorly and often wholly disappear before the vent. The head is olivaceous-brown, fading laterally to pearly-whitish, yellow, or orange on the lips. There is, I think, always a blackish vertical short loreal streak, and generally some of the last supralabials are margined posteriorly with black. The chin is whitish, and the throat pearly-white, pale, or bright yellow, or orange, these vivid hues being seen alike in some specimens of both the blue and red varieties. The belly is pearly-whitish, with generally some roundish, scattered, small, lateral black spots, chiefly anteriorly. Often an ill-defined pinkish or lilac suffusion is to be seen at the edge of the ventral shields. When desquamation is impending much of the beautiful colouring may be obscured, but when once the little snake has divested itself of its old and seedy-looking raiment, it is just the little dandy that its specific name implies.

(*a*) Variety *typica:* In this the overlapped margins of the scales, especially towards their bases, are adorned with blue-gray or pale blue, often of a shade almost identical with that very beautiful flower *Plumbago capensis*. This ornamentation is concealed by the imbrication of the scales when the snake is

quiescent, and only comes into view when the snake under alarm or excitement inflates itself. It is much more conspicuous, or may be wholly confined to the anterior half or third of the body. This is the common type which is universally to be met with throughout the area of its distribution in plains and hills alike.

(*b*) Variety *erythrostictus* (Wall): In this, the far more beautiful variety, bright vermilion replaces the blue adornment of variety *typica*. The vermilion, however, is usually, if not always, more extensively distributed than the blue of the last variety, so that it is usually more or less evident even in the quiescent state of the snake. Specimens so ornamented frequently have a speckling of the same hue on the belly and in many, though not in all, the throat is yellow or orange. It has been suggested that the brilliant hues here alluded to are acquired during the breeding season, but this is not so. They may be seen in hatchlings and at all times of the year.

Habits.—(*a*) *Haunts:* Its choice of a home, of course, depends upon its food, but though this consists of frogs and toads, I cannot recall ever having met with one actually in the water. The reason is obvious, for during the season when it is in evidence—the rains—the whole country is wet enough to make frogs abundant everywhere, and even when the land is drying, or dry, short of drought, many species of frogs that do not congregate in collections of water are in hiding and toads too. I know full well that in captivity water is essential to its well-being, and I have had specimens that were to be seen at times more or less immersed in their basins. Ferguson says: "In captivity it is fond of lying in water"; and Mr. E. E. Green, in a letter to me writes: "It submerges itself in its bath at rare intervals, and remains there for many hours." Nicholson remarks that "in dry weather the offer of a drink will at once gain their hearts." Though it is not the swimmer or hydrophile that *piscator* is, it is frequently to be met with in damp situations, such as drying paddy fields and the banks of canals; and Mr. Millard remarks that in October near Bombay "it is exceedingly common in the rice fields, where one sees them constantly, probably attracted by the crop of young frogs."

During the rains the buff-striped keelback distributes itself broadcast all over the land and will be found in grassy and cultivated areas of open country, but does not favour arid plains nor jungle tracts. It is commonly to be met with in gardens, grass farms, golf links, and similar situations about cantonments, and further afield in "crops" or any waste ground that has some sparse cover and might harbour frogs.

It sometimes wanders into outhouses and bungalows, and especially in such of the latter where pot plants are available. In Rangoon once I had as many as four sent to me in one morning by a neighbour who flushed them in his verandah whilst re-arranging his ferns, &c.

The crepuscular gloom beneath the foliage of closely congregated pot plants and the humidity derived from daily watering furnishes an ideal environment for mosquitoes and other insects upon which frogs subsist, and there are always some pots with a chip out of their basal rims large enough to act as doorways to cosy quarters—from a batrachian standpoint—beneath. The same environment offers effectual concealment for the little buffstripes and a plethora of its food supply. One of the four snakes above alluded to had swallowed a single frog, and another was replete with three inside. A specimen sent to our Society by Mr. Dwane from Madras was discovered on the horn of a living buffalo, a very curious situation for any snake.

When not roaming about the country it often secretes itself in holes in the ground, or takes refuge in the masonry of drains, culverts, wells, outhouses, and such situations. I have sometimes detected one with its head issuing from a hole in the ground, but the slightest movement on my part caused a sudden retraction below the surface, followed after a few minutes by its re-appearance, when, if satisfied that the coast was clear, it emerged and glided off.

(*b*) *Disposition:* This is a remarkably inoffensive little creature. Of all the snakes I know, it ranks among the most gentle, for I have picked it up scores of times in its native haunts, and I have never once been bitten or even struck at. Mr. Millard writes to me: "It is the most gentle snake that I

know. I cannot remember one ever having attempted to bite even when caught in the open." Little "buffstripes" is easily alarmed and when danger threatens, turns and glides off as rapidly as possible to any protection the nature of the ground may offer, and it is an adept in the art of concealing itself in the smallest patch of scrub or grass, sometimes vanishing in a most uncanny way. Probably it has found a hole and secreted itself therein, but a careful and systematic search sometimes fails to reveal the mystery of its disappearance. When brought into the open it exhibits a lively activity, making repeated attempts to escape.

(*c*) *Posture of Alarm:* When irritated, some specimens, but by no means all, erect themselves flattening the neck and forebody ventro-vertebrally. This flattening process involves a much greater length of the forebody than is seen in the cobra, and I have seen the whole body flattened to the vent. In the cobra the degree to which it is manifested laterally is far greater than is seen in any of the keelbacks and their allies. During this erection and flattening of the forebody, *stolatus* distends itself by deep drawn inspirations, bringing into view those beautiful ornamentations of blue or vermilion, as the case may be, to which I have referred in dealing with its colour and varieties. This behaviour is never anything more than a demonstration of alarm, possibly a menace, the snake looking as if it intended mischief, but though I have irritated it as much as I knew how, I never had one attempt to bite me.

(*d*) *Nocturnal or Diurnal:* The buff-striped keelback is essentially diurnal in habit. It is met with abroad at any hour of the day, but is not usually encountered at night, though its relative *piscator* is frequently on the move under cover of darkness.

(*e*) *Progression:* Though agile and active, its movements are not rapid. It always appears to me that its progression is much smoother than that exhibited by many snakes.

(*f*) *Æstivation:* This snake evinces a very marked disposition to æstivate, disappearing for some months during the drought of a hot weather, to re-appear with the first heavy rains that announce the inauguration of the monsoon. This fact has evidently been noted by the observant native

hence the names "wana* kukroo," "wanna pamu," and "wanna cogli." Only recently, too (February), Mr. Millard tells me he has offered rewards for them in Bombay, but the natives say they cannot guarantee getting them, except in the rains, when they are plentiful.

In Rangoon Evans and I got no single example in 1900 before April 30, the day the rains broke, but from May 2 to August 2 no fewer than 21 specimens were brought in. Similarly, in Cannanore in 1904, during the drought, between January 1 and March 18, I got only one specimen out of a total of 60, but from March 19 to June 4, between which dates a few desultory showers fell, there were 3 out of 71 snakes collected, and from June 5, the day the big monsoon burst, to the end of July out of 81 specimens, no fewer than 38 were *stolata*. In Fyzabad in 1906, during the drought, between January 1 and June 18, the day the rains broke, I had received a solitary specimen, but after this I obtained 6 out of 21 specimens in June, and no fewer than 87 in July and August, out of a total of 485 snakes of all kinds.

(*g*) *Hibernation:* In Northern India it disappears during the cold months of the year, hibernating beneath the soil. In December, 1904, several were unearthed by the Sepoys of the 62nd Punjabis, when out in camp near Rae Bareilly in December. They were found singly at a depth of from 9 to 18 inches below the surface, chiefly in the roots of clumps of giant grass, and when dislodged were dull and inactive.

(*h*) *Sloughing:* We know very little about this function, and although many snakes are kept in captivity in various institutions in India, very little attention is paid to this curious habit, and seemingly no records kept. Similarly, in Regent's Park, London, I failed to get any information.

A specimen I had in Rangoon sloughed on June 27 and again on July 24. Another cast its skin on May 7 and 25, and again on June 23 in Rangoon. Some excellent records were kept some years ago in the Madras Museum,† from which I find that one specimen desquamated on June 29, October 21,

* "Wana" = rain (Telugu).

† Administration Report, 1896.

December 22, 1896, and January 25, 1897. Another exfoliated on December 22, 1896, and January 25, September 3, December 14, 1896, and on January 18 and February 27, 1897. This was the same specimen that laid 14 eggs between August 17 and September 18. In another specimen ecdysis occurred on March 17, September 17, December 26, 1896, and March 20, 1897. It is very difficult to explain why in one instance four months elapsed and in another six months during the same period of the year in which a third specimen desquamated from every three to five weeks. All the specimens, judging from the consumption of frogs, which I have quoted under food, appeared to have been in vigorous health, all the records were made in the same year, and we may assume that all the specimens were caged under similar conditions. It seems unlikely, too, that when special attention was being given to this function, any of the occasions should have been overlooked.

Food.—Its diet is almost entirely batrachian in character, and whilst some show a decided partiality towards frogs, others find toads more attractive. In India it is usually the frogs *Rana cyanophlyctis* or the young of *R. tigrina* that form its principal sustenance, these being, perhaps, the commonest frogs to be met with. For the same reason young toads of the species *Bufo melanostictus* are most frequently devoured. I have known *R. breviceps* and *Microhyla ornata* taken in Fyzabad, and *Oxyglossus lævis* and a species of *Rhacophorus*, probably *leucomystax*, in Burma, On several occasions I have found toads ingested, once a young *Bufo andersoni* in Fyzabad having proved the victim. I once found a gecko in a young one in Assam, but have never heard of a lizard being taken, except on this occasion, and never a mammal. Usually a single frog or toad satisfies its appetite, but I have more than once found as many as three in the stomach.

Colonel G. H. Evans, whose attention was once arrested by pitiful wails, found on investigation a frog in the jaws of a *stolata*. It had been seized "a posteriori," and the snake when discovered made tracks without releasing its captive, and succeeded in reaching a crevice in the ground some thirty yards away, down which it managed to insinuate itself by

some lateral manœuvre head last, still retaining hold of the frog. It was dug out, and froggie when released hopped away. Mr. Millard, who has known this species in captivity for over twenty years, tells me that it feeds greedily on frogs, in fact he "cannot remember ever having seen it feed on anything else." On the other hand, Mr. E. E. Green, who has a very intimate knowledge of the species in Ceylon, tells me that in captivity "it will look at nothing but the toad *Bufo melanostictus*," and he relates how on one occasion two *stolata* seized the same toad in his vivarium, each proceeding to swallow from opposite points of seizure, till their noses met, when the larger snake began to engulf the smaller, but at this stage of the proceedings he interfered. In the Madras Museum one buff-striped keelback ate 131 toads in the year. another 130, and a third 91 green frogs. Murray says that in Sind, like *piscator*, it lives in pools and feeds on fish. If this is a fact, its habits in that locality are different from those manifested in other parts of India.

Foes.—Doubtless so harmless and diminutive a reptile frequently provides food for predaceous animals and birds. Evans and I once knew it fall a victim to the snake *Xenopeltis unicolor*, and I found one inside a banded krait (*Bungarus fasciatus*) in Dibrugarh. Mr. Primrose some years ago recorded one being swallowed by the green tree snake (*Dyrophis mycterizans*).

Breeding.—(*a*) *The Sexes:* It is remarkable that though the sexes are very evenly balanced in many parts of India in some localities, notably Assam, there is a great disparity in favour of the female. Thus, out of 37 specimens sexed in Cannanore, 20 were male and 17 female ; and out of 118 sexed in Fyzabad, 57 were male and 61 female. In Assam—hills and plains—females are more than twice as numerous, for out of 89 specimens sexed in Dibrugarh, 62 were female ; and in Shillong, in the Khasi Hills, no fewer than 16 out of 21 specimens proved to be this sex. In a clutch of 5 eggs brought to me in Dibrugarh, there were 4 females and 1 male. The female is usually at all times longer than the male. Starting from the egg it frequently has a slight advantage, it more than maintains this as growth advances, and finally attains

proportions considerably in excess of the male, as will be mentioned under "maximum length" (page 120).

The relative proportions of the body and tail are subject to slight variation in individuals of both sexes, but I can discover no disproportion of sexual import.

The anal glands in both sexes furnish a greenish-yellow secretion of the consistency of custard.

The male claspers are beset with numerous horny, claw-like, curved processes, which must function as anchors. The nearly allied species, the "grass snake," so common in England (*T. natrix*), I have more than once encountered *in copula*. When disturbed, instead of detaching themselves, the larger and more powerful female made for the nearest cover, dragging her partner unceremoniously behind.

It seems as if these processes, which are re-curved so as to oppose any traction efforts, serve to maintain attachment during such an emergency. Their development is such and they are so numerous, that they must provide a very firm grip during the turgid state of the organ, and I can well imagine that if under inordinate strain the parties were pulled asunder, the female parts would sustain severe laceration.

(*b*) *Method of Reproduction: Stolata* is oviparous in habit. I have had specimens in captivity that have discharged eggs.

(*c*) *Season:* It is a curious fact that though this snake goes into retirement during the hot months in the plains, this appears to be the season when matrimonial intercourse is for the most part indulged in. This is evidently so in many cases, judging from what we know of the period elapsing between coitus and the deposition of eggs. The sexes must, therefore, in many instances retire in pairs, for when the rains burst, and the species re-appear, many, if not most of the females, are already impregnated, and often to an advanced degree.

In Cannanore in 1904 a few showers at intervals of several days fell between March 18 and May 18, and frequent showers between May 20 and June 4. On June 5 the monsoon burst, and *stolatus*, up to this time a rarity, became abundant. I obtained a gravid female in May and four in June. In Fyzabad in 1906 the rains broke on June 18, when *stolatus*, up to this date hardly in evidence, became numerous. I got one

gravid female in June, nineteen in July, and four in August. In Rangoon in 1900 the rains broke on April 30, up to which date I had no specimen of *stolata*. On May 30 I got a female with eight eggs in an advanced stage of development. I have never had the good fortune to meet with a pair in conjunction, and have only had them rarely reported so. In Cannanore a pair was reported *in copula* on May 24, and two pairs were similarly reported on June 18.

In Burma Theobald reported an egg-bound female—precise locality not specified—in May, and Nicholson a similar specimen in Rangoon in the same month. Evans and I had gravid females in Rangoon twice in May, twice in June, twice in July, and once in October.

In Cannanore I had one egg-bound female in May, four in June, and four in July.

In Fyzabad I had one gravid female in June, nineteen in July, and seven in August.

Nicholson reported an egg-bound female in Bangalore in August.

In Dibrugarh I had twelve gravid in April, thirteen in May, two in June, and one in July. In Shillong three specimens in an advanced stage of impregnation were brought to me in August.

A specimen from Hakgalla, Ceylon (4,600 feet), was egg-bound in September.

In Rangoon I had a specimen that laid eggs in August. In Cannanore a female deposited her eggs on July 29, and another laid eggs in August. In Fyzabad one deposited eggs in August. The Madras specimen, already referred to, oviposited in August and September.

I have frequently had eggs in clutches brought to me unearthed after deposition under natural conditions. In Rangoon once in June, in Dibrugarh several in May (once as early as the 1st) and June, and in Shillong once in August.

The full complement of eggs is discharged normally within a few hours, but some specimens in captivity have discharged them fitfully at intervals. A specimen I captured in Fyzabad on July 7 laid one egg that night, and discharged ten more on the night of the 12th of the same month. A

specimen in the Madras Museum* laid fourteen eggs as follows :—August : one on the 19th, one on the 20th, two on the 22nd ; September : three on the 12th, three on the 14th, one on the 15th, and three on the 18th, occupying a full month in the accomplishment of this function.

Snakes are credited with the power to retain their ova, or fœtuses, when circumstances are unfavourable for their deposition, but, of course, they cannot do so indefinitely. An unsuitable environment such as is likely to occur under captivity may explain the spasmodic discharge of the eggs in the above instances, but even in the vivarium the dam usually deposits her full complement within a few hours.

(*d*) *Period of Gestation :* This is not exactly known, but it is probable that it will prove to be of the same duration as in the chequered keelback *piscator*, viz., about two months. A specimen of mine in Cannanore captured on June 21 laid five eggs on July 29. As the specimen was obviously gravid when caught, gestation must considerably exceed five weeks. A specimen in captivity in the Madras Museum, whose date of capture was unfortunately not recorded, laid the first of fourteen eggs on August 17. As it was noted that the specimen sloughed on June 28, at least seven weeks elapsed before the discharge of this egg. The dam at full term retires to any convenient refuge in the ground, and there deposits her eggs some few inches below the surface. Unlike some other snakes she does not appear to be attended by her consort at or subsequent to this eventful period. I have only once known a male in company with a female after impregnation. This was in Fyzabad in July. The two snakes were described as confronting one another with reared bodies, and they remained actively engaged in this manner for some minutes. Both were killed, and I sexed them and found the female in an advanced state of impregnation. It is impossible to know whether this was a chance encounter, which seems probable, or whether their behaviour was of an amorous or hostile character.

The parent having laid her eggs remains with them for some time, perhaps even till they hatch. During hoeing operations

* Administration Report, Madras Museum, 1896 to 1897.

on the tea estates around Dibrugarh, on several occasions a female was unearthed and brought to me with her eggs. Frequently eggs were brought without the dam, but with the report that a snake had been seen with them. On one occasion eggs brought with the attendant parent were found to contain embryos 2¼ to 3 inches long.

It seems certain that the parent is not unremitting in her attentions, for on several occasions when eggs were unearthed the cooly upon interrogation denied that there was any snake with them.

(*e*) *Period of Incubation:* This almost certainly depends upon temperature, and should, therefore, be more protracted in the hills than in the plains.

In Rangoon a female laid nine eggs on August 11, which hatched a month later, viz., one on September 10 and six on September 11. The remaining eggs were non-fertile. I feel certain from other observations and the conditions under which these eggs were placed that the incubating period was artificially abbreviated. They were placed on damp cotton wool, inside a wide-mouthed, stoppered bottle and placed within a couple of yards or so of an earthenware basin containing live embers. These fire receptacles are in ordinary use in Burma in the rains and are placed beneath a wicker cage on which one's clothes are placed to dry. Though the bottle was stood outside the cage, it must have derived considerable heat from the contained embers.

(*f*) *The Eggs:* Inside the parent the ova lie in a single string like the beads of a necklace, their long axes disposed in the length of the body. They do not overlap one another, nor lie transversely, as is the case with their more prolific relative *piscator*. In their later stages, owing to pressure within a contracted space, their poles are strongly flattened against one another, but no suggestion of this flattening is seen after they are discharged.

Immediately after expulsion, the egg investment is moist and sticky, so that many or all the eggs become firmly adherent to one another to form a cluster. They are pure white in colour, and the ovicular investment pliant like white kid. They are soft to the touch, and their tension rather firmer than that of a

grape. The poles are equally domed, and the eggs measure from 22 to 35 mm. ($\frac{7}{8}$ to $1\frac{3}{8}$ inches) in length, and 16 to 18 mm. ($\frac{5}{8}$ to $\frac{3}{4}$) of an inch in breadth. Eggs in the same clutch always vary somewhat in their dimensions, but what one lacks in length is usually compensated for in girth. They sink in water.

When freshly oviposited they contain a custard-like material in which a minute embryo, perhaps one inch long if unravelled, can be discerned if carefully investigated.

It is extremely difficult to place eggs artificially under conditions favourable to their incubation. One of two things usually happens, either they shrivel up, or become mouldy within a few hours, according as to whether their environment is too dry or too wet. It is certain that they require a humid atmosphere, and, I believe, a light approaching twilight, if not darker. After many unsuccessful attempts at incubation, I find the best way to treat them is to put them on fresh earth every day under an inverted flower pot. I turn up earth in the morning to a depth depending on the humidity of the soil, and select that which is slightly damp, and put this to a depth of 3 or 4 inches in a vessel and the eggs on the top. The inverted pot gives them the darkness I think essential, and then the vessel is placed in a shady place. The following morning the earth will be found already too dry, and if not changed, the eggs shrivel very rapidly.

Stolata is not very prolific as snakes go. I have over 80 records of egg-bound females and clutches of eggs that have been laid, and find that it may lay from one to fourteen eggs, but from five to ten is the usual number.

Growth.—(*a*) *Intraoval Development:* In Dibrugarh, where the climate and temperature are much the same as Burma, I had eggs brought to me on May 21, containing embryos $4\frac{3}{8}$ inches in length, but they did not hatch out till June 10, when they measured 6 and $6\frac{3}{8}$ inches respectively. In this case the embryos grew about two inches in twenty-one days, or about one-third the length they attain to within the egg. Allowing a similar rate of growth for the whole of intraoval life, and a length of 1 inch when the eggs were laid, the embryos would have been about thirty days acquiring a length of $4\frac{3}{8}$ inches

and the whole period would be about fifty days. Again, in Shillong, on August 18, I had eggs brought to me which contained embryos. Twenty days later, viz., on September 2, I extracted an embryo measuring 3¼ inches, or about half the length of a hatchling. Allowing 1 inch for the embryo when the eggs were discharged, the growth was 2¼ inches in twenty-five days, and the total period of incubation would work out at about fifty days. (Fig. 25.)

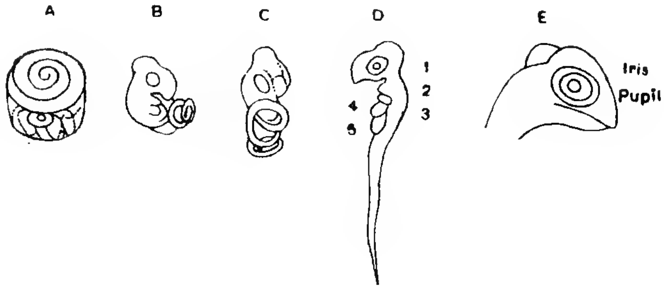

FIG. 25.—Showing the development of Amphiesma stolata.

A. Coiled in egg.
B, C, D. The same after extraction.
E. The head of same enlarged.

(*b*) *The Hatchling* : The embryos liberate themselves from the egg by means of an osseous structure, which is specially developed for this purpose, and is very soon—a day or two—shed after its function has been fulfilled. This is called the fœtal tooth or egg tooth, and is developed in the premaxillary bone. Unlike the ordinary teeth, which are already developed at this stage of life, it is flattened, and its cutting edge lies horizontally, projecting forward beneath the arch in the front of the mouth, which is formed to admit of the protrusion of the tongue when the jaws are closed. With this instrument the embryo makes one or many incisions, which penetrate the egg shell, but even when it has established an adequate means of exit, the little snake seems loathe to abandon its cradle, for

it sometimes wholly withdraws itself within the shell after having almost vacated it, and often, after lying with its head and forebody emerging, many hours elapse before it finally disengages itself and effects its entry into the world.

In Rangoon I had one lot of embryos hatching out on August 1 and 3, another on September 10 and 11, and on a third occasion on October 22 (not November as previously reported in the Bombay Natural History Journal, Vol. XIII., p. 351). In Dibrugarh I had embryos hatching on June 10, and others on July 5 and 6.

In Cannanore I had a hatchling $6\frac{1}{4}$ inches long on November 21, one in Dehra Dun $5\frac{7}{8}$ inches long on October 8, one in Bangalore $7\frac{1}{2}$ inches on September 29, two in Fyzabad measuring $5\frac{3}{4}$ and $6\frac{1}{4}$ inches in October, and two measuring $5\frac{7}{8}$ inches in November.

At the time of hatching the male has the genitals ensheathed and concealed from view, but I have had an embryo of $6\frac{1}{4}$ inches length in which they were extruded, showing that it is only at a very late stage of embryonic development that their invagination occurs.

When the hatchling first leaves the egg, it may or may not have part of the yolk sac adhering to the navel. This orifice, or the recently obliterated remains of it, is very apparent in the hatchling and remains so for some months, but eventually becomes completely effaced. At exovation from 14 to 18 ventral shields intervene between it and the anal shield and the scar itself involves two or even three ventrals.

When the hatchling vacates the egg it is from $5\frac{1}{4}$ to 7 inches in length, and there is little difference in the length of the sexes, for in one brood two males were 6 and $6\frac{7}{8}$, and two females $6\frac{3}{4}$ and 7 inches, respectively. In another brood one male was 5 7/32, and four females 5 5/16, $5\frac{3}{8}$, $5\frac{1}{2}$, and $5\frac{7}{8}$, respectively. In a third case a male was $6\frac{1}{4}$ and a female of the same clutch $6\frac{1}{8}$ inches. It is curious this being the case that all through my notes the average measurements of the female in each month appreciably exceed those of the male, and this becomes increasingly apparent till by the end of the second year there is a disparity of 2 inches or more in favour of the female.

(*c*) *Early Life:* As far as I can judge, the young double their length in the first year of life and have trebled it by the end of the second, and any further increase in length is small and slow.

(*d*) *Maturity:* The smallest gravid female I have had was 442 mm. (1 foot 5½ inches) long, but many have been from 457 to 470 (1 foot 6 inches to 1 foot 7 inches), all lengths attained at the end of the second year. It is evident, therefore, from my numerous records that the majority of individuals mate at this early age. It is interesting to note from the measurements of hatchlings given above, all of which were from Dibrugarh, how close the measurements of individuals in the same brood run, whilst there is an appreciable difference in the average length of members of different broods.

(*e*) *Maximum Length:* I have about 200 recorded measurements in my note books and find that the length differs considerably in the sexes. Of males, I have only had eight specimens of 530 mm. (1 foot 9 inches) and over, of which only four reached 555 mm. (1 foot and 10 inches), the largest being 567 mm. (1 foot 10½ inches). On the other hand, I have had thirteen females exceeding 620 mm. (2 feet) in length. Two taped 710 mm. (2 feet 4 inches) in Dibrugarh, and another 735 mm. (2 feet 5 inches) in Fyzabad. Another specimen from Dibrugarh I judge to have been still larger, for the body was 600 mm. (1 foot 11½ inches) out of a total length of 710 mm. (2 feet 4 inches). In three females in which the total lengths were 622, 647, and 653 mm. (2 feet ½ an inch, 2 feet 1½ inch, and 2 feet 1¾ inch), the tails measured 152 and 160 (6 and 6¼ inches) respectively, so that at the lowest computation this specimen would have been, if perfect, 2 inches longer, and possibly 3, making a length of 762 to 785 mm. (2 feet 6 or 7 inches).

Parasites.—(*a*) *Entozoa:* The buff-striped keelback harbours many entozoa. One of these is a maggot-like creature called *Porocephalus crotali* (see Fig. 21). It is whitish in colour, about three-quarters of an inch long, and attaches itself to the tissues about the entrails of the snake, but is not found in the intestine or solid organs. Several are to be found in the same snake, but always solitary. The head,

which is its thickest part, is furnished on its ventral aspect with four curved claw-like hooks, yellowish in colour, and placed around the mouth. By these it attaches itself to the mesenteric folds. The body, which gradually reduces in girth posteriorly, consists of about thirty subequal segments. It no doubt sucks the blood of its host.

Another parasite, and one which must seriously affect the health of its host, is a nematode worm called *Kalicephalus willeyi* after Dr. Willey, the Director of the Colombo Museum. This I have only found in the stomach attaching itself to the inner coats of that organ, but Von Linstow says it also inhabits the intestine of many snakes. It is of a gregarious habit, and the several members of a single colony vary very much in length, the longest being as much as 5 inches. It is about as thick throughout as the catgut on a tennis racquet, reddish-brown in colour, with a grayish-white caudal extremity. The head, as shown by Von Linstow, is compressed and is furrowed dorsally and ventrally. The mouth is large and has six papillæ, three on each side, situated around its margin. The body appears to be depressed and its surface smooth. Often more than one cluster of these worms is found to have invaded the stomach. This organ, as a result of these parasites, becomes knuckled and distorted, and its walls very much thickened, cartilaginous, and rigid, so that it would appear doubtful if it could distend sufficiently to accommodate the relatively enormous bulk that is so often swallowed at a meal.

A third parasite infesting *stolata* is a larval form of tapeworm, which, though sent to Professor Von Linstow, he could not further determine than that it was a species of *Pterocercus*. These parasites are white and flattened and locate themselves usually beneath the lining membrane of the abdominal cavity, but sometimes beneath the dorsal integument, where they form flat blister-like swellings. When these are cut into, the parasite is found in a convoluted mass, which when unravelled may measure up to 10 inches in length. They do not seem to invade any hollow or solid organ. They exist in large numbers in some specimens, even to the extent of making the host appear gravid,

(*b*) *Hæmatozoa:* Clifford Dobell ("Spolia Zeylanica," December, 1910) has found no less than three blood parasites infesting this species. These are (1) *Trypanosoma tropidonoti.* This is an actively motile organism, which lives free in the blood stream, and measures, including its flagellum, 30 to 40 mm. (1 to 1½ inches) in length. The body is sharply pointed at both extremities and has a granular central trophic nucleus. The undulating membrane ends anteriorly in the flagellum and posteriorly in an oval body—the kinetic nucleus—which is situated at or rather behind the trophic nucleus. It is not known how these affect the health of their hosts. The snake may have acquired an immunity, as in the case of wild African ungulates, against the *Trypanosoma brucei,* or suffer in health like ungulates infected with *Trypansoma evansi,* the causative agent of surra. (Fig. 26.)

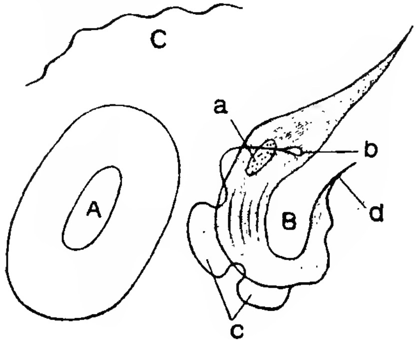

FIG. 26.—A. Red blood cell.
B. Trypanosoma (after Dobell)—
(a) Trophic nucleus.
(b) Kinetic nucleus.
(c) Undulating membrane.
(d) Flagellum.
C. Spirochæta tropidonoti.
Parasites of Amphiesma stolata.

(2) *Spirochæta tropidonoti.*—This is a slender, corkscrew-like, actively-motile organism, which lives free in the blood stream. It measures about 15 mm. (1⅝ of an inch) in length. Dobell suggests that the snake may be infected through the agency of a tick, to which I may add a mite (Microtrombidium). It is not known how this affects the snake's health. (*Vide* Fig. 26.)

(3) Dobell also found a hæmogregarine in the blood of *stolata*, which he opines may prove to be the same organism isolated by Billet in 1895 from a specimen of this snake from Tonkin, and named by the latter *Danilewskya stolati*. Hæmogregarines invade the red blood corpuscles. (*Vide* Fig. 39.)

Lepidosis.—(*a*) *Typical:* As detailed under the genus. *Præoculars:* One. *Temporal:* One; about as long as the supraocular. *Supralabials:* Eight; the 1st only touching the nasals, 3rd, 4th, and 5th touching the eye, 6th and 7th the temporal (Fig. 27). *Infralabials:* Seven; the 5th, 6th, and

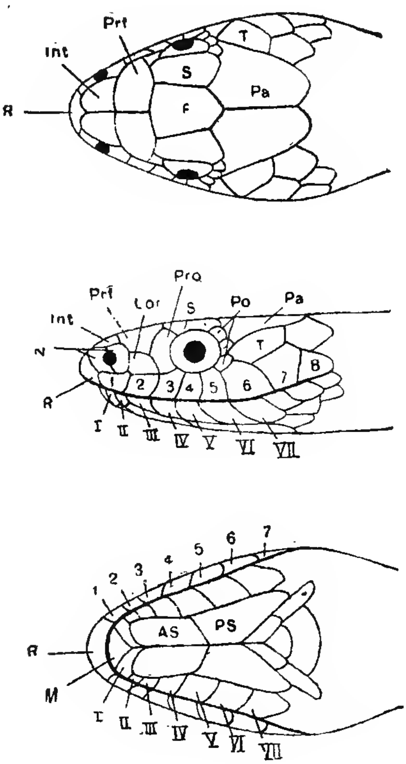

FIG. 27.—Amphiesma stolata.
(× 2.)

7th touching the posterior sublinguals, 7th broader than the posterior sublinguals, but not so long, touching three scales behind. *Costals:* Emarginate; keeled in all rows, except the last, for a variable extent anteriorly (Fig. 28). Apical

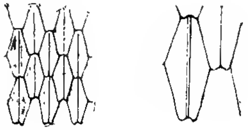

FIG. 28.—Scales of Amphiesma stolata to show apical emargination.

facets in pairs are often obscure. *Supracaudals:* Keeled till after the rows have reduced to fours. *Ventrals:* 120 to 161. *Anal:* Divided. *Subcaudals:* 46 to 89 (Fig. 29).

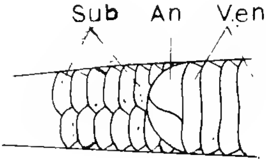

FIG. 29.—Anal region of Amphiesma stolata.

(*b*) *Anomalies.—Loreal:* Sometimes duplicated $\frac{1}{1}$. *Præoculars:* Rarely two. *Postoculars:* Rarely two or four. *Temporals:* Rarely two. *Supralabials:* Frequently two or more are confluent, making six, with the 2nd and 3rd, 3rd only,

or 3rd and 4th touching the eye ; seven, with the 3rd and 4th or 4th only touching the eye ; rarely nine, with the 4th, 5th, and 6th touching the eye. *Anterior sublinguals :* I have once seen these divided.

Dentition.—*Maxillary :* Præcranterian 20 to 22 ; Cranterian 2 ; fully twice the size of the preceding. *Palatine :* 15 to 17. *Pterygoid :* 25 to 31. *Mandibular :* 28 to 31.

Distribution.—(*a*) *General :* The whole of Southern Continental Asia, from Sind in the west to China in the east. It also occurs in the Island of Ceylon, probably the Andamans, though I can find no record from this group, the Nicobars, Hainan, Hong Kong, Formosa, and the Philippines.

(*b*) *Local :* This species is a resident in the plains, but wanders to an altitude in the hills, which varies with the locality. Its relative abundance in various districts in the plains and the altitude to which it wanders is interesting. In the low-country in Ceylon Mr. Willey reports it the commonest snake to be met with. Mr. E. E. Green tells me that in Kandy (1,700 feet) it is quite common, and Mr. Pearless says that at Badulla (2,500 feet) it is very common, but at Hakgala (5,600 feet) I only got one specimen out of 80 collected.

In Cannanore, out of 377 snakes collected, 2 in every 13 were of this species, but at Paralai in the Anamallays (3,500 to 4,000 feet) I got no specimen out of 91 sent me in 1909. I am told, however, by the Rev. E. M. Gombert, S.J., that it is common in the Palnai Hills (Shembaganur) between 5,000 to 6,000 feet.

In Fyzabad, out of 704 snakes, 2 in every 9 were *stolata*, but in the Western Himalayas at Almora (5,300 feet) I got only 2 in 38 snakes of all kinds in 1909. In the Bengal Plains it is evidently very common, for I got 7 specimens out of 25 sent me from the Jalpaiguri District, but out of a collection of 778 made in the Eastern Himalayas below Darjeeling (1,500 to 7,000 feet) only one *stolata* came to bag, this being found

below 2,800 feet. The diffeience in the altitude to which it wanders in this, compared with the western part of the same mountain range, is certainly noteworthy.

In the plains of Assam, out of 615 snakes collected, 1 in every 4 was a *stolata*, and in the Khasi Hills at Shillong (4,900 feet) it was nearly as common, for among 264 snakes collected, 1 in every 7 was this species.

In Lower Burma, out of 615 snakes, mostly collected about Rangoon, 1 in every 15 was a *stolata*. I have had a specimen from Haka in the Chin Hills (6,500 feet).

Genus MACROPISTHODON.*

(Greek "makros" large, "opisthe" behind, "odous" tooth.)

General Characters.—Small snakes, 3 feet or less. Head subovate, snout short, with rounded canthus, and bluntly-rounded extremity. Eye moderate, pupil round. Nostril open, round, in the upper two-thirds of the suture between the nasals. Neck evident. Body cylindrical, robust, attenuating from the middle in both directions. Belly rounded. Tail short to moderate, from about one-ninth to four-ninths the total length.

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* I question whether this genus is entitled to rank as distinct from *Amphiesma*, on the characters of the maxillary dentition, upon which it appears to be entirely based. The only difference I can find in the figures in Boulenger's Catalogue (Vol. I., pp. 245 and 265) is that the posterior maxillary teeth are relatively larger than in *Amphiesma*. This may be true of some of the species of *Amphiesma*, but in others, notably *subminiata* and *himalayana*, the posterior maxillary teeth are relatively as long or almost as long as in *Macropisthodon plumbicolor*. I find good grounds, however, in the lepidosis for separating *M. plumbicolor* from *Amphiesma* and its nearest allied genera.

Identification.—There is no easy guide to the recognition of the genus, but the following syndrome will best indicate it. Costals about one-third as broad as long, and one-third as broad as the ultimate row, in 21 to 27 rows at midbody; and seven supralabials.

Habits.—Terrestrial, diurnal. The diet is mainly of a batrachian order. The best known species is oviparous.

Poison.—All are non-poisonous.

Lepidosis.—*Rostral:* Touches six shields, the rostro-nasal sutures longest. *Internasals:* Two; the suture between them equal to, or nearly equal to, that between the præfrontals, equal to, or nearly equal to, the internaso-præfrontals. *Præfrontals:* Two; the suture between them equal to, or nearly equal to, the præfronto-frontals. *Frontal:* Touches six shields; the fronto-supraocular sutures twice, or nearly twice, the fronto-parietals. *Nasals:* Two. *Loreal:* One. *Præoculars:* One or two. *Postoculars:* Three. *Temporals:* Two; the lower as long as the supraoculars. *Supralabials:* Seven or eight; two touching the eye. *Infralabials:* Six or seven; the last three touching the posterior sublinguals. *Sublinguals:* Two pairs; the posterior larger.

Costals.—Longer than broad, rectiform, keeled, with apical facets, apically emarginate. The vertebrals not enlarged. Ultimate row enlarged, the breadth of its scales as long as their length, about three times the breadth of the vertebrals. In 19 to 27 rows at midbody. *Supracaudals:* In even rows. *Ventrals:* 120 to 162; rounded. *Anal:* Divided. *Subcaudals:* 35 to 60; divided.

Dentition.—*Maxillary:* Diacranterian; the præcranterian set isodont. Cranterian; two; strongly compressed, and much enlarged. *Palatine:* Isodont. *Pterygoid:* Isodont, except last two or three, which are reduced. *Mandibular:* Isodont, except last two or three, which are reduced.

Distribution.—Peninsular India, Ceylon, Malay Peninsula, Islands of Malay Archipelago as far east as Java.

There are three species only, one of which occurs in Peninsular India and Ceylon, viz., *plumbicolor.*

Macropisthodon plumbicolor Cantor.*

(Latin "plumbum" lead, "color" colour.)

The Green Keelback.

Sinhalese: "Pala polonga" (herb snake) (Fletcher). *Tamil:* "Pacha naga" (green cobra).

Synonymy.—*Tropidonotus plumbicolor, Xenodon viridis, Trigonocephalus ellioti, Amphiesma brachyurum, Halys ellioti.*

History.—First described by Cantor in 1839.

General Characters.—A small snake, about 2½ feet in length. Head subovate. Snout short, with a rounded canthus, and broadly-rounded extremity. Eye moderately large, iris greenish-gold, especially evident at its pupillary margin, and the pupil round. Nostril round, rather large, occupying the upper two-thirds of the suture between the nasals. Neck fairly evident. Body rather stout, cylindrical, thickest about the middle, from which it attenuates anteriorly and posteriorly. Belly rounded. Tail short, about one-seventh to one-ninth the total length.

Identificaton.—The following syndrome will distinguish it from all other Ceylon snakes. Costals in midbody 21 to 27, anal divided, and supralabials seven.

Colouration.—Adults are a uniform grass-green dorsally, with a few irregularly-disposed black spots anteriorly, which have a tendency to form transverse bars, and a few scattered small whitish spots. The head is grass-green above, merging to white on the upper lip. A black streak passes from the eye to the gape. The chin, throat, and belly are uniform white or buff, or the belly may be greenish or plumbeous to blackish.

Young specimens are so different from adults that many do not recognize them. They have a well-defined black chevron on the nape, with the angle pointed forwards. Behind this is a broad gorget of bright yellow or orange (dirty whitish in spirit specimens), bordered posteriorly with black.

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* The specimen submitted to Cantor must have been an old one preserved in poor spirit to have acquired a colour so different from that observed in life, and so inappropriate a name.

The green bright though it is, is not due to green pigment. A yellow pigment overlies the scales like a varnish. This is soluble in spirit, to which it imparts its colour, leaving the specimen first bluish, then blue, and finally plumbeous. Boiling the skin rapidly dissolves out the yellow pigment, and reveals the underlying blue of the scales. Some specimens are darker than others, and when the yellow pigment is removed acquire a plumbeous hue. The skin is slate-coloured or dun, spotted and mottled with whitish, except in the flanks, where it is white. Short white lines arranged so as to form chevrons pointed forwards are seen in the skin where it is dun. There is also a series of white ring-like spots in the skin, on either side of the 9th and 10th costal rows above the ventrals, a feature I have not observed in any other snake.

Habits.—(*a*) *Haunts:* Its colouration is protective, for it frequents grass and low terrestrial vegetation. It does not usually clamber into trees and bushes, but one sent to me from Coorg was reported found on a coffee branch. It very frequently strays into bungalows, and I have had many sent to me with a history of its incursion into habitations. Miss Montgomery found one at Broach in an empty soda water bottle in damp straw in her godown.

(*b*) *Disposition:* It is a singularly gentle and inoffensive snake. When provoked I have never seen it bite, nor when it has been picked up in its native haunts.

(*c*) *Posture of Menace:* When encountered and alarmed, it erects its forebody and flattens the neck like a cobra to a remarkable degree, and it is, no doubt, this attitude which has gained for it the name of green cobra, which some estate coolies call it in India. Some specimens are very timid and crouch, flattening the whole body to the vent on to the ground.

(*d*) *Nocturnal or Diurnal:* It is frequently encountered in the daytime in grass and low scrub jungle, and appears to be loath to quit such an environment by day. I have frequently, however, encountered it at night crossing roads or in open spaces.

(*e*) *Sloughing:* Mr. D'Abreu tells me that one in captivity at Nagpur sloughed five times during four months, and another three times in the same period.

(*f*) *Progression:* It is an active snake that can move quite expeditiously if so inclined.

(*g*) *Æstivation:* The green keelback appears to disappear during the drought, and like frogs and some other snakes, notably *Nerodia piscator* and *Amphiesma stolata*, suddenly appears with the advent of the rains.

Food.—Its staple food consists of the common Indian toad, *Bufo melanostictus*. A large number of the 106 specimens collected for me in the Nilgiri Hills in 1917 had recently fed, and almost invariably this toad had furnished the meal. I have noted the partiality to this diet also in Bangalore specimens. In many cases the snake is enormously distended. A specimen sent to me measuring 3 inches in girth was distended to 5¼ inches, and the head of the ingested toad was fully twice the transverse diameter of the snake.

I have known frogs taken on three occasions, always varieties of *Ixalus*. Fletcher mentions a captive specimen in Ceylon eating three frogs, and at another time a lizard of the Genus *Calotes*. Mr. Gray told me he once knew one eat a snake.

Breeding.—(*a*) *The Sexes:* Of 39 sexed by me in the Nilgiris, 26 were males and 13 females. Females appear to attain a greater length than males.

(*b*) *Method of Reproduction:* Eggs are produced.

(*c*) *Season:* This evidently covers a considerable part of the year. A specimen I had in captivity at Bangalore that died on February 16 had ovarian follicles obviously fertilized. Abercromby mentions having had egg-bound females in Ceylon in May and the beginning of June.

Mr. D'Abreu tells me that one in captivity at Nagpur deposited six eggs on March 18 and a seventh on April 1. Another specimen laid three eggs on March 20, and thirteen more on the following day.

Miss Montgomery wrote to me of a brood, evidently just hatched, that was found in a disused water vessel at Broach at the end of March or beginning of April.

I have had hatchlings varying from 136 to 168 mm. (5⅘ and 6¾ inches in length in the months of July, August, and September, and other specimens in September from 185 to 255 mm. (7¼ to 10 inches), showing that the longest had hatched out some months earlier.

(*d*) *Period of Gestation:* Not accurately known, but Mr. D'Abreu's second specimen alluded to above was acquired on December 26, so that at least eighty-five days had elapsed since the act of mating.

(*e*) *Period of Incubation:* Not known.

(*f*) *The Eggs:* Mr. D'Abreu says the eggs were oval, and equally domed at both ends. One egg from the first clutch measured 36 by 21 mm. (1·45 by ·69 inch). An egg from the second clutch measured 25 by 22 mm. (1 by ·7 inch).

Growth.—(*a*) *The Hatchlings:* I have had many hatchlings between 136 and 168 mm. (5⅘ to 6¾ inches). One of Miss Montgomery's brood was reported to be 187 mm. (7⅜ inches) long.

I found three follicles fertilized in one specimen and twelve in another. Mr. D'Abreu's two clutches numbered seven and sixteen. Miss Montgomery's hatched brood numbered thirty-one.

(*b*) *Early Life:* The young appear to double their length in the first year of life. I cannot follow the subsequent growth from my records.

(*c*) *Maturity:* My smallest gravid female measured 450 mm. (1 foot 5¾ inches), a length suggesting that her age was about eighteen months to two years.

(*d*) *Maximum Length:* My largest male record is 750 mm. (2 feet 5½ inches). My largest female record is 890 mm. (2 feet 11 inches). I have had several other females over 760 mm. (2 feet 6 inches). Colonel Light has recorded one 940 mm. (3 feet 1 inch).

Parasites.—(*a*) *Ectozoa:* Two young examples in the Nilgiri Hills were infested with many small scarlet mites, which were pronounced species of *Microtrombidia* by Professor Hirst. These are extremely like the little mite called the harvest bug in England (*M. holosericeus*).

Lepidosis.—(*a*) *Typical—Rostral:* Nearly twice as broad as high, in contact with six shields; the rostro-nasal sutures longest (Fig. 30). *Internasals:* Two; the suture between them

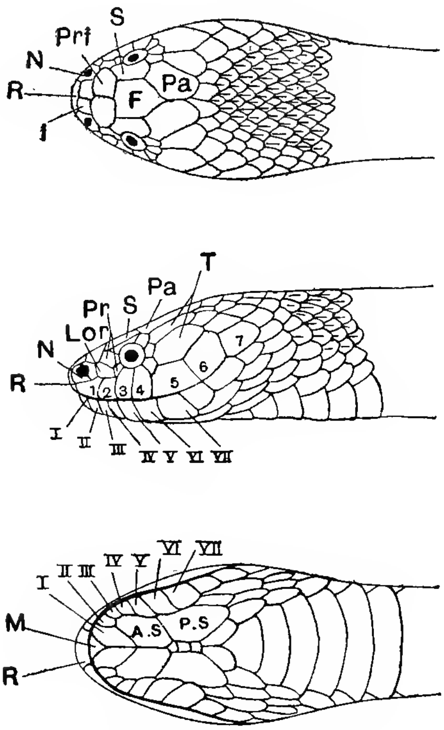

Fig. 30.—Macropisthodon plumbicolor (life size).

two-thirds to subequal to that between the præfrontals; three-fourths to subequal to the internaso-præfrontals. *Præfrontals:* Two; the suture between them subequal to, or rather less than the præfronto-frontals; in contact with internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* Touches six

shields; the fronto-supraocular sutures less than twice the fronto-parietals. *Supraoculars:* As long as the frontal; and about half the breadth of the frontal along a line connecting the centres of the eyes. *Nasals:* Two; the nostril equally in both, occupying the upper two-thirds of the suture. *Loreal:* One; often confluent with the lower præocular; when not, it is much shorter than the nasals. *Præoculars:* Two. *Postoculars:* Three. *Temporals:* Two; the lower well developed, and as long as the supraoculars. *Supralabials:* Seven; the 1st and 2nd touching the nasals, the 3rd and 4th the eye, and the 5th and 6th the lower temporal. *Sublinguals:* Two pairs; the posterior longer, and in contact with the 5th, 6th, and 7th infralabials. *Infralabials:* Seven; the 7th touching three scales behind; twice as broad as the posterior sublinguals, but not so long.

Costals: Much longer than broad, rectiform, strongly keeled, except in the ultimate row for a variable distance; apically emarginate usually (sometimes not). Apical facets in pairs, usually very obscure. Vertebrals not enlarged, the breadth of its scales two-fifths to one-third their length, two-fifths to one-third those of the ultimate row. Ultimate row enlarged, the breadth of its scales equal to their length. The rows number from 21 to 27 in midbody, are usually two less two heads-lengths behind the head, and usually six (sometimes eight) less two heads-lengths before the vent. The increase in rows anteriorly is due to the development of a row on each side of the vertebral. The decrease in rows is brought about by the absorption of the row next to the vertebral once, and either the 4th, 5th, or 6th row from the ventrals at the other steps. *Supracaudals:* In even rows, all keeled to the tail tip. *Ventrals:* 144 to 163; rounded. *Anal:* Divided. *Subcaudals:* 34 to 50; divided.

(*b*) *Anomalies.*—The loreal is frequently confluent with the lower præocular. There are sometimes only two, sometimes four postoculars. The infralabials are sometimes only six, and then the 4th, 5th, and 6th touch the posterior sublinguals.

Dentition.—From two skulls in my collection. *Maxillary:* Præcranterian 12. Cranterian 2; strongly compressed,

and three or nearly three times the length of the preceding. *Palatine:* 7. *Pterygoid:* 12 to 14. *Mandibular:* 16 to 19. (Fig. 31.)

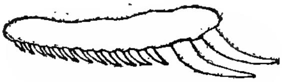

FIG. 31.—Maxilla of Macropisthodon plumbicolor.

Distribution.—(*a*) *General:* Ceylon and Peninsular India. Its northern boundary in India is roughly the 30th parallel, and its western and eastern limits roughly the 70th and 85th meridians.

(*b*) *Local:* It is chiefly an up-country snake, which reaches an altitude above 6,000 feet. It favours an altitude between about 2,000 and 6,000 feet, and is quite a common snake within this belt. Some stragglers reach the plains, but nearly always in the near vicinity of hills. In Ceylon Ferguson records it from Palliekellie; Haly from Balangoda, Badulla, and the Northern Province; Pearless from Moragalla; Abercromby from Anuradhapura. Mr. Drummond-Hay tells me it is common on the Uva patanas between about 3,000 and 4,000 feet, but he has never obtained it elsewhere.

Genus HELICOPS.

(Greek "helis" rolling; and "ops" eye.)

General Characters.—For Indian species. Smallish snakes growing to about 2½ feet. Head moderate in length, little depressed. Snout moderate, narrowing slightly, rounded terminally, with little indication of a canthus. Eye moderate, with round pupil. Nostril slit-like, placed rather high on the

muzzle. Body cylindrical, rather short, robust, rough. Belly rounded. Tail moderately long.

Identification.—The scale rows 19 two heads-lengths behind the head, 19 in midbody, and 17 two heads-lengths before the vent, and a single internasal will establish the genus.

Habits.—Semiaquatic, diurnal.

Food.—Chiefly batrachian.

Breeding.—Oviparous.

Poison.—Non-poisonous.

Lepidosis.—As detailed under the species *schistosus.*

Dentition.—For Indian species. *Maxillary:* Syncranterian, anododont, coryphodont. *Palatine:* Anododont, isodont. *Pterygoid:* Anododont, isodont. *Mandibular:* Anododont, feebly kumatodont.

Distribution.—America, Tropical Africa, South-east Asia.

Eleven species have been described, nine of which are American, one African, and one occurs in India, including Ceylon, viz., *schistosus.*

HELICOPS SCHISTOSUS Daudin.

(Latin "schistosus" slaty. The name was suggested by the colour shown in Russell's plate.)

The Olivaceous Keelback.

Synonmy.—*Coluber schistosus, Pseudoeryx schistosus, Tropidonotus dimidiatus, T. schistosus, T. mœstus, T. surgens, Tropidophis schistosus, Atretium schistosum.*

History.—Introduced to scientific notice by Russell in 1801, who figured it in Plate IV. of his second volume. Christened by Daudin in 1803.

General Characters.—A smallish snake, growing to about 2½ feet. The head is moderate, snout short, subacute, and

without canthus, and the neck fairly evident. The eye is moderate, with a round pupil. The nostril is small, slit-like, and placed rather high, approximating to the condition seen in the true fresh-water snakes (*Homalopsinæ*). The body is fairly robust, cylindrical, and rough from the keeled scales. It attenuates somewhat anteriorly and posteriorly. The belly is rounded. The tail is longish, being about one-fourth to one-third the total length.

Identification.—The costals in 19 rows anteriorly to behind midbody, 17 behind, and the single internasal shield will distinguish this from all other Ceylon snakes. It bears a close superficial likeness to Gerard's water snake (*Gerardia prevostiana*).

Colouration.—(*a*) Variety *typica :* Dorsally this snake is a uniform deep olive-green in life, fading in spirit to olive-brown. The under parts are uniform yellow of varying intensity in different specimens, and this is sometimes suffused with a pinkish or lilac tinge in the flanks. The two colours are abruptly demarcated on the penultimate row of costals. The head is olive-green above, merging to yellow, or pinkish on the lips. Gunther says the young have a blackish streak from the eye continued on to the forepart of the body.

In Southern India the specimens exhibit a narrow reddish line along the confines of the 5th and 6th rows above the ventrals, where the scale rows are 19, and the 4th and 5th where 17. This line ceases at the vent, and is more conspicuous in males than females.

(*b*) Variety *andersoni:* In this the internasal shields are two in number, and the 1st and 2nd supralabial shields touch the nasal. It is peculiar to Yunnan. I have examined three specimens in the Indian Museum, which conform to the characters and colouration of variety *typica,* except in the particulars specified above.

Habits.—(*a*) *Haunts :* The olivaceous keelback exhibits a strong taste for an aquatic environment, and the position and character of its nostrils conforming to the type seen in the true fresh-water snakes (*Homalopsinæ*) in itself proclaims the snake a water snake by habit. In Fyzabad I got no specimen

during nineteen months' residence, but when the river overflowed its banks and flooded the country for miles in August, 1906, I had eight specimens brought to me in fourteen days, all from the inundated area. It by no means haunts rivers to the exclusion of tanks and similar collections of water, nor does it show a greater liking for flowing water, for in Bangalore, where it was very common, it was found haunting the small collections of water in the Lal Bagh and other similar pools elsewhere. The snake men there denied that it was a water snake, and said they never found it actually in the water, but at the edge of the pools, where the dank soil favoured a luxuriant growth. They also frequently encountered it in the foliage and lying along the stems of the bamboo brush near the water. In the rains, I think it leaves the vicinity of pools and wanders further afield, there being abundant moisture in the grass and weeds that spring up everywhere. I have met with it in the grass at some distance from water during the monsoon, and remember capturing one which crossed the pitch at Berhampur, while a cricket match was in progress. Ferguson remarks that one he had in captivity in Trivandrum was never seen to enter the chatty of water provided for it, and Mr. Ingleby mentions that a caged specimen he had invariably buried itself in the sand at the bottom of its cage with nothing but the extremity of its head and its eyes sticking out.

(*b*) *Disposition:* Though Cantor remarks that the species is very fierce, and Ferguson quotes Ingleby's words to the same effect, I have invariably found it very much the reverse; in fact, I know of no Indian snake with a more inoffensive nature and nicer manners. I am not courageous where snakes are concerned, and object strongly to being bitten even by species that I know to be harmless, so I am always chary of handling them, but this species, like the buff-striped keelback (*Amphiesma stolata*), is so remarkably gentle that I pick it up fearlessly, and have never been struck at or bitten. Even the two I had conjoined in Bangalore permitted my handling them and making close investigation, without resenting the interference further than to try and elude my grasp.

(*c*) *Nocturnal or Diurnal:* It is completely diurnal in habit.

(*d*) *Progression:* It is a vivacious little reptile, active in movement, and as alert as any snake I know. When alarmed it raises the forebody well off the ground and flattens the neck like the cobra, but to a much less degree. It is this posture which, I think, has misled some who have pronounced it fierce.

(*e*) *Æstivation:* It appears to me to retire during the hot weather, and is little, if at all, in evidence until the monsoon breaks and vegetation springs up afresh.

Food.—Specimens I had in captivity fed on frogs, and Mr. Ingleby found the frogs that he offered were taken. Gunther includes fishes in its dietary. I cannot recall ever having got a specimen that had recently fed in a state of liberty.

Breeding.—(*a*) *The Sexes:* As far as I can judge from my notes, the sexes in Fyzabad and Bangalore are evenly balanced. Females attain a considerably greater length than males, but males have relatively much longer tails, and, therefore, more numerous subcaudal shields. The males of the South Indian variety appear to have a brighter red dorsal line, and females appear to be able to flatten themselves more noticeably. The male claspers are cylindrical, not bifid, and beset from base to apex with small falciform processes.

(*b*) *The Act of Mating:* A pair were brought to me in Bangalore *in coitu.* These were observed united, reclining on a bamboo stem 8 or 10 feet above the ground. On the evening of the 26th an attempt was made to capture them, but not pressed, as the snake men feared they would not earn their reward of Rs. 5 if they separated. They were successfully captured next morning, and brought to me still united, and I had them under observation for some time. As far as I know, they did not disengage for at least 25½ hours. During this time I repeatedly examined them, and found the left clasper of the male engaged with the right orifice of the female. The ventral apposition of the two was so limited that nobody seeing them together would have suspected that they were coupled. They each lay in sinuous courses, without their bodies or their tails being enwreathed, and there was

nothing demonstrative in their attachment as far as I could see at any time. Unfortunately the union was unfruitful, due, I believe, to my moving north to the United Provinces immediately after. The cold weather so far depressed the natural vigour of a *Macropisthodon plumbicolor* I also took from Bangalore with me, that a frog it swallowed remained undigested for some weeks, and was subsequently disgorged, and when the snake died five months and six days subsequently to its capture, it was found to be gravid with the impregnated follicles, but little enlarged, and much in the same state as the impregnated follicles of the *schistosus* at death.

(*c*) *Method of Reproduction:* The species is known to be oviparous from a cluster of eggs which Tennent* refers to, which was found near a river in Ceylon, and from which twenty young snakes subsequently emerged. Abercromby confirms this, and I can further support this testimony.

(*d*) *Season:* The mating season appears to be during the rains from the single dated observation available, which came under my own notice. None of the four adult females I had in Fyzabad were gravid, which points to the deposition of eggs being already accomplished before August, unless mating had up till then not been in progress. The latter possibility is suggested by the pair found in *copula* in Bangalore, and brought to me on August 27. Abercromby has reported a captive specimen in Ceylon laying eggs on April 26. I had two gravid females sent me from Bangalore with eggs in an advanced state of development. It is almost certain these were captured in November. I had a specimen from Bangalore killed on December 9, 1919, with eggs in an advanced state of development. On January 1, 1920, one in my vivarium deposited eggs in Bangalore.

(*e*) *Period of Gestation:* Not known.

(*f*) *Period of Incubation:* Not known.

(*g*) *Number in Clutch:* I had a gravid specimen from Ceylon with 10 eggs. My impregnated female from Bangalore contained 18 fertilized follicles, and three other egg-bound

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* Natural History of Ceylon, p. 308.

females from Bangalore contained respectively 20, 21, and 25 eggs. My specimen deposited 18 eggs; and Abercromby's specimen laid 32 eggs. In the latter case 13 were laid, and the dam after death was found to contain 19 more.

(*h*) *The Eggs :* Tennent and Abercromby failed to give any information concerning the physical characters of the eggs. The eggs deposited in my vivarium were white, soft, the consistency of a grape, the poles equally domed, and the length 300 to 305 mm. (about 1 inch).

Growth.—(*a*) *The Hatchling:* Tennent does not enlighten us on this point. My smallest specimens, which appeared to me hatchlings, measured 167 and 174 mm. ($6\frac{5}{8}$ and $6\frac{7}{8}$ inches), both from Ceylon, with no dates of capture given.

(*b*) *Early Life:* From rather meagre records at my disposal it appears that it grows about 6 to 7 inches a year, so that at the end of the first year of life it would be about 13 to 14 inches, at the end of the second about 19 to 20, and the end of third about 25 to 26 inches.

(*c*) *Maturity:* My smallest gravid specimen measured 717 mm. (2 feet $4\frac{1}{4}$ inches).

(*d*) *Maximum Length:* My largest specimen was 775 mm. (2 feet $6\frac{1}{2}$ inches) long.

Lepidosis.—*Rostral :* Touches five shields ; the rostro-nasal sutures longer than the rostro-internasals, and the rostro-labials. *Internasal :* One. *Præfrontals:* A pair ; the suture between them subequal to, or rather longer than, the præfronto-frontal ; touching the internasal, nasal, loreal, præocular, and supraocular. *Frontal :* Touches six shields; the fronto-supraocular sutures nearly twice the fronto-parietals. *Supraoculars:* As long as the frontal, and about half to two-thirds the breadth of the frontal. *Nasal :* Semi-divided, a suture passing from the nostril to the first labial. *Loreal :* One ; rather shorter than the nasals. *Præocular:* One, not nearly touching the frontal. *Postoculars :* Three. *Temporals :* Two ; the lower about as long as the supra-oculars. *Supralabials:* Eight ; the 1st only touching the nasal, 3rd and 4th the eye, and the 5th, 6th, and 7th the lower temporal. *Sublinguals :* Two pairs; the posterior rather longer than the anterior, divergent, touching the 4th, 5th, and

6th infralabials. *Infralabials:* Six; the 5th and 6th subequal; 6th broader than the posterior sublinguals, but much shorter than them; touching three scales behind. (Fig. 32.)

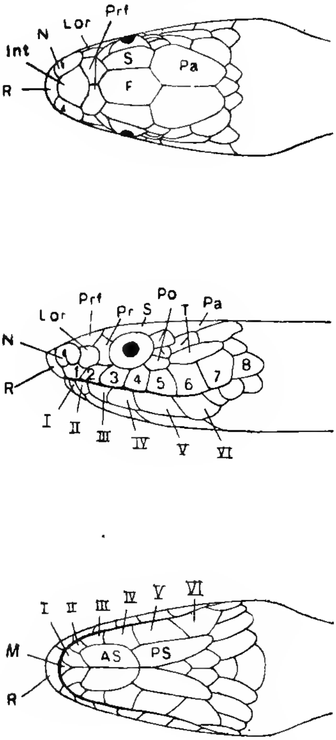

FIG. 32.—Helicops schistosus.
(Life size.)

Costals: Longer than broad, rectiform, apically emarginate, keeled, except in the last two or three rows at midbody. Vertebrals not enlarged, the breadth of the scales about two-thirds their length, and about half that of the ultimate row. Last seven rows progressively enlarging. Ultimate broadest, the breadth of its scales subequal to or rather greater than their length. In 19 rows to behind midbody, where they

reduce to 17 by an absorption of the 4th row from the ventrals. *Ventrals:* 129 to 157; rounded. *Anal:* Divided. *Supracaudals:* In even rows, keeled as far as the fours. *Subcaudals:* 55 to 85; divided.

(*b*) *Anomalies.—Internasals:* Divided in Variety *andersoni*; in some Variety *typica* there are three, one anterior and two posterior. *Præfrontals:* Rarely three, in a transverse series. In Variety *andersoni* three or four. *Postoculars:* Rarely two. *Supralabials:* Rarely seven. Sometimes nine, with the 4th, 5th, and 6th touching the eye. *Infralabials:* The 5th, 6th, and 7th sometimes touch the posterior sublinguals. *Ventrals:* I have seen the last divided like the anal.

Dentition.—From three skulls in my collection. *Maxillary:* 19 to 24. *Palatine:* 11 to 13. *Pterygoid:* 17 to 20. *Mandibular:* 20 to 23.

Distribution.—(*a*) *General:* Peninsular India from about the 15th parallel southwards, the Coromandel Coast, and the Ganges basin, as far east as Calcutta. Yunnan, Ceylon.

(*b*) *Local:* It is a moderately common snake in the plains of India, and ascends to a moderate height in the hills. It is a common snake at Bangalore (3,000 feet). In Ceylon Haly records it from Kandy and Balangoda. I have seen specimens from Kandy, and Mr. Drummond-Hay tells me it was common at Punagalla, Yatiyantota District, up to about 3,000 feet.

Genus HAPLOCERCUS.

(Greek "haplos" single, and "kerkos" tail; refers to the subcaudal shields, which are undivided.)

General Characters.—As detailed under the species.

Lepidosis.—As detailed under the species.

Distribution.—The genus is peculiar to Ceylon.

Only one species is known, viz., *ceylonensis*.

HAPLOCERCUS CEYLONENSIS Gunther.

(Latin implying an inhabitant of Ceylon.)

Synonymy.—*Aspidura carinata, A. ceylonensis.*

General Characters.—A small snake, growing to about 18 inches. Head moderately depressed. Snout moderately long, broadly-rounded terminally, without any canthus. Eye moderate, with round pupil. Nostril in the upper half of the suture dividing the nasals. Neck not at all contracted. Body long, cylindrical, slender, of even calibre throughout. Belly rounded. Tail short, about one-seventh the total length.

Identification.—Bears a close superficial resemblance to *Callophis trimaculatus.* The costals in 17 rows in the whole length of the body, entire subcaudals, and 7 supralabials will suffice to identify the species.

Colouration.—Dorsally brown, with a blackish vertebral line. A lateral series of small blackish spots. There is an oblique yellowish, black-edged stripe on each side of the neck in young specimens, which may disappear with age. Ventrally uniform yellowish.

Habits.—(*a*) *Haunts:* Lives for the most part beneath the soil. Mr. Drummond-Hay tells me many were unearthed when cleaning out the silt from drains in company with large number of *Rhinophis blythi* and occasional specimens of *Aspidura copei.* Mr. Green says he has noticed them in the evening sometimes crawling about the roads.

Food.—I opened up many and found earthworms in the stomach, and liquid mud in the intestines.

Breeding.—(*a*) *The Sexes:* Of 38 in Mr. Drummond-Hay's collection, 18 were males and 20 females. Females appear to grow longer than males, and males have rather longer tails.

(*b*) *Method of Reproduction:* I examined several egg-bound females. The eggs, from their size and character, leave no doubt that the species is oviparous.

(*c*) *Season:* This is not known, as no dates were available.

(*d*) *The Eggs:* In three specimens I found only two eggs, and in another three. Those most advanced were extremely elongate, measuring 310 by 5 mm. (1$\frac{3}{16}$ by $\frac{3}{16}$ of an inch). No trace of an embryo could be discovered.

Growth.—(*a*) *The Hatchling:* The smallest specimens I have measured were 137 and 140 mm. (5½ and 5⅝ inches), but as the navel appeared well closed, it is probable that the young when hatched are even smaller.

(*b*) *Early Life:* Want of dates make it impossible to follow the rate of growth.

(*c*) *Maturity:* The smallest of four egg-bound females measured 370 mm. (14⅝ inches).

(*d*) *Maximum Length:* The longest male was 342 mm. (13½ inches), six females exceeded 355 mm. (14 inches), the longest being 417 mm. (16½ inches), and 450 mm. (17¾ inches).

Lepidosis.—(*a*) *Typical—Rostral:* Touches three shields, owing to the confluence of the nasal and 1st labial. *Internasals:* One. *Præfrontals:* A pair; the suture between them rather longer than the præfronto-frontal; touching the internasal, nasal, 2nd and 3rd labials, præocular, and supraocular. *Frontal:* Touches six shields; the fronto-supraocular sutures subequal to the fronto-parietals. *Supraoculars:* Length about three-fourths the frontal, breadth about three-fifths the frontal along a line connecting the centres of the eyes. *Parietals:* Much longer than the frontal. *Nasals:* Two; the anterior confluent with the 1st labial. *Loreal:* Absent. *Præocular:* One, not reaching the frontal. *Postoculars:* Two. *Temporal:* One, longer than the supraocular. *Supralabials:* Seven; 1st and 2nd touching the nasal, 3rd and 4th or the 4th only the eye, 5th and 6th the temporal; last longest. *Sublinguals:* Two pairs; the anterior twice as long as the posterior; posterior touching the 4th

infralabial. *Infralabials :* Four ; 4th largest, longer than the posterior sublinguals, and about as broad, touching two scales behind. (Fig. 33.)

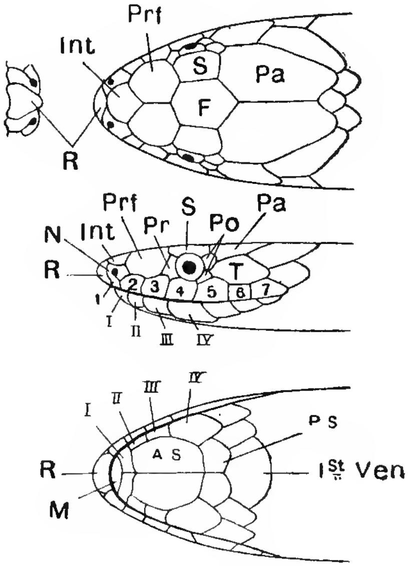

FIG. 33.—Haplocercus ceylonensis.
(× 2½.)

Costals: At midbody. Longer than broad, rectiform keeled, except the last two or three rows. Vertebrals not enlarged, the breadth of the scales half their length, and half the ultimate row. Last five rows progressively increasing in breadth. Ultimate row broadest, its scales about as broad as long. In 17 rows in the whole body length. *Ventrals:* 177 to 217 ; rounded. *Anal :* Entire. *Supracaudals :* In odd rows, keeled to the tip of the tail. *Subcaudals:* 37 to 56 ; entire.

(*b*) *Anomalies:* The supralabials are sometimes six.

Dentition.—From two skulls in my collection. *Maxillary :* 11 to 12. *Palatine :* 9 to 10. *Pterygoid :* 19 to 21. *Mandibular :* 10 to 12.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* Mr. Drummond-Hay found it abundant at Hopewell estate, Balangoda district, between about 3,500 and 4,200 feet. Has been recorded from Pundaloya, about 4,000 feet, and Ramboda. Apparently an up-country species.

Genus LYCODON.

(Greek "lukos" wolf, and "odous" tooth. There is an enlarged tooth near the front of both maxilla and mandible, reminding one of the canine teeth in wolves, foxes, and dogs.)

General Characters.—All these species are small snakes, rarely exceeding 2 feet in length. Body cylindrical, rather slender, elongate, the calibre reducing slightly posteriorly. Belly angulate or rounded. Neck slightly evident. Head rather depressed. Snout broadly rounded, without canthus. Eye moderate, and entirely black in life, so that the pupil, which is vertical in shape, is not discernible. Nostril moderate, occupying the whole depth of the suture between the nasals. Tail shortish, being about one-quarter to one-sixth the total length.

Identification.—The costals in 17 rows anteriorly, 17 at midbody, and 15 posteriorly, and three labials touching the eye will suffice to indicate the genus.

Habits.—Terrestrial, nocturnal, active, fierce.

Food.—Small mammals, lizards.

Breeding.—Oviparous.

Poison.—Non-poisonous.

Lepidosis (for Indian Species).—*Rostral:* Touches six shields. *Internasals:* A pair. *Præfrontals:* A pair, *Nasals:* Divided. *Loreals:* One or two. *Præocular.* One. *Postoculars:* Two. *Temporals:* Two. *Supralabials:* Eight or nine, three touching the eye. *Sublinguals:* Two pairs, subequal, or the posterior longer.

Costals: About as broad as long, or a little longer than broad, rectiform, with or without keels, with single apical

pits. Vertebrals not enlarged. Ultimate row enlarged. *Ventrals :* Rounded or angulate. *Anal :* Entire or divided. *Subcaudals :* Divided.

Dentition.—*Maxillary :* Diacranterian, dinododont, anisodont. *Palatine :* Anododont, isodont. *Pterygoid :* Anododont, isodont, except for the last four or five, which reduce in length. *Mandibular :* Oinododont, anisodont.

Distribution.—Southern Asia.

Twelve species have been described, of which two occur in Ceylon, viz., *striatus*, and *aulicus*.

Lycodon striatus Shaw.

(Latin "striatus" striped.)

Shaw's Wolfsnake.

Tamil : "utha surita" (I am informed by Mr. Green).

Synonymy.—*Coluber striatus, C. malignus, C. galathea, Lycodon malignus, L. galathea, L. napei, L. aulicus.*

History.—First referred to by Russell in 1796, who showed two illustrations in his first volume (Plates XVI. and XX VI.). Christened by Shaw in 1802.

General Characters.—A small snake, less than 18 inches in length. Head small, snout much depressed, and broadly rounded. Neck but little evident. Eye moderate. The nostril occupies the whole depth of the suture between the nasals. Body cylindrical, rather slender, smooth, attenuating very slightly posteriorly. Scales glossy. Belly rounded. Tail short, being about one-fifth to one-sixth the total length.

Identification.—The costals two heads-lengths behind the head 17, at midbody 17, and two heads-lengths before the vent 15 ; the loreal touching the internasal ; and ventrals rounded, not angulate, should make its identification an easy matter. It shows a close superficial resemblance to *Bungarus cæruleus*, and the other Ceylon species of this genus. *Aulicus* and *striatus* are frequently confused, and I have found many in various Museums wrongly identified. The easiest mistake to make is in counting the supralabials. The last of the series is so small and scale-like that it is frequently not included in the

count. To prevent this open the mouth and count to the end of the gape. I have purposely avoided reference to these shields in the above features of identification.

Colouration.—Dorsally lustrous dark brown or black, with from 11 to 18 white or yellow crossbars on the body. These bars are more distant anteriorly, and expand in the flanks to include deltoid islets of the ground colour. They are more broken, and less regular on the tail. The head is dark brown or black, except the upper lip, which is white. The belly is pearly-white and unspotted. In Ceylon specimens the ground colour is dark brown, and the crossbars are frequently sullied with pale brownish.

Habits.—(*a*) *Haunts :* I have known this snake in the house, like its commoner ally *aulicus*. One in Fyzabad came into the Cantonment Hospital, and another was encountered in the Officers' Mess of the 85th K.S.L.I. Three or four were unearthed at different times during digging operations. It hides during the daytime in holes in the ground, heaps of débris, crevices of brickwork, stacks of wood, or road metal, &c.

(*b*) *Disposition :* All the specimens I have seen alive exhibited a very timid disposition. I never knew one strike, no matter what the provocation. Usually it made no endeavour to escape, but coiled itself, and, if touched or teased, hid its head beneath its coils, looking out cautiously from time to time to see if the danger apprehended had disappeared. It sometimes flattens itself to the ground in a remarkable way.

(*c*) *Nocturnal or Diurnal:* Like the common wolfsnake, it is decidedly nocturnal. I met with two at different times at night on the road between the mess and my house at Berhampore (Orissa), and on both occasions there was no endeavour to retire from the situation, no attempt at menace. Except the specimens encountered while digging, nearly all were killed at night.

(*d*) *Progression:* I have never seen one actually moving. It does not seem to indulge in the clambering efforts of its closely allied relative *aulicus*.

Food.—The few that have come into my hands that had recently fed contained skinks of the Genus *Mabuia*. One of Mr. Green's examples had swallowed a skink (*Mabuia carinata*).

Breeding.—(*a*) *The Sexes:* I can discover no external differences in the sexes. After mating they are found in company even after the deposition of the eggs.

(*b*) *Method of Reproduction:* The species is known to be oviparous. I have had the eggs brought to me with the mother in attendance.

(*c*) *Season:* I have known a gravid female with small eggs in August, and another in the same month with large eggs seemingly fit for discharge. Mr. Green acquired a gravid specimen in August. Eggs that had been deposited were brought to me also in August.

(*d*) *Period of Gestation:* Not known.

(*e*) *Period of Incubation:* Not known.

(*f*) *The Eggs:* It is not a prolific snake. The eggs vary from two to four. They are white, soft-shelled, very large for the size of the snake, and very elongate, with the poles equally domed. They vary from 25 to 30 mm. (1 to $1\frac{1}{5}$ inches) in length, and are about 10 to 12 mm. in breadth ($\frac{3}{8}$ of an inch).

Growth.—(*a*) *Length of Hatchling:* Not known.

(*b*) *Maturity:* My smallest gravid female taped 276 mm. ($10\frac{7}{8}$ inches).

(*c*) *Maximum Length:* Boulenger gives this as 430 mm. (nearly 1 foot 5 inches). My largest specimen was 394 mm. (1 foot $3\frac{1}{2}$ inches).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures longer than the rostro-internasal, about twice the rostro-labials. *Internasals:* The suture between them half to two-thirds, that between the præfrontals, subequal to or rather longer than the internaso-præfrontals. *Præfrontals:* Touching the internasal, loreal, præocular, supraocular, and frontal, the suture between them longer than the præfronto-frontal. *Frontal:* The fronto-supraocular sutures subequal to the fronto-parietals. *Supraoculars:* Length three-fourths the frontal; breadth about half the frontal, along a line connecting the centres of the eyes. *Nasals:* Anterior deeper. *Loreal:* One; longer than the nasals; touching the internasal. *Præocular:* Not nearly touching the frontal. *Temporals:* Lower, half the length of the supraocular. *Supralabials:* Eight,

the 1st and 2nd touching the nasals, 3rd, 4th, and 5th the eye, and 6th and 7th the lower temporals. *Sublinguals :* Pairs subequal, the posterior touching the 5th and 6th infralabials. *Infralabials :* Six; the 6th nearly as long as the posterior sublinguals, and nearly twice as broad as those shields, touching three scales behind.

Costals : Smooth. Vertebrals about as broad as long, four-fifths that of the ultimate row. Ultimate row slightly enlarged, about as broad as long. Two heads-lengths behind the head 17, in midbody 17, two heads-lengths before the vent 15. The rows reduce to 15 shortly behind midbody by the absorption of the third row from the ventrals. *Ventrals :* 144 to 189; not angulate (Ceylon specimens 144 to 159). *Anal :* Divided. *Subcaudals :* 34 to 66 (Ceylon specimens 34 to 42); divided.

(*b*) *Anomalies.—Loreal :* Rarely divided into an anterior, and posterior part. *Temporal:* Rarely one. *Supralabials :* Sometimes two are confluent to make seven, or there may be a supernumerary shield to make nine. In the former case the 3rd and 4th only touch the eye. In the latter the 3rd, 4th. 5th, and 6th rarely touch the eye. *Anal :* Rarely entire.

Dentition.—From one skull in my collection. *Maxillary :* Prænodal 5; the first three progressively increasing in length, the next two subequal, and about twice the length of the third. Postnodal 4. Cranterian 2; subequal, and about twice the length of the preceding. *Palatine:* 11. *Pterygoid:* 12 (?). *Mandibular :* Prænodal 5; the first three progressively increasing in length, the last two subequal, and about twice the length of the third. Postnodal 12 to 13; small and subequal.

Distribution.—(*a*) *General :* Peninsular India to the Himalayas. On the north-west it extends through the Punjab, Sind, Baluchistan, and Persia to Transcaspia. To the north-east it extends to about the longitude of Calcutta.

(*b*) *Local :* It frequents the plains, but I have a record of a specimen from the Palnai Hills at 6,000 feet. In Ceylon it is evidently less uncommon than past records make it appear. Perhaps it has been confused with *aulicus*. Mr. Green obtained it at Peradeniya. Mr. Drummond-Hay has never had a specimen on his estates.

Lycodon aulicus Linné.

(Latin "aulicus" a house dweller, from its frequent intrusion into human habitations.)

The Common Wolfsnake.

Tamil: "vala panayan" (smooth snake), "kattu viriyan" (banded snake), "shungu viriyan" (shell snake), from the marks on the back. *Sinhalese:* "tel karawala," "alu polonga."

Synonymy.—*Coluber aulicus, Lycodon capucinus, L. unicolor, L. hebe, Tyleria hypsirhinoides.*

History.—First referred to and christened by Linné in 1754. Russell in 1801 figured it in his second volume (Plate XXXIX.)

General Characters.—Head pear-shaped, depressed. Snout markedly depressed, with broadly rounded extremity, and no canthus. Neck slightly constricted. Body rather elongate, cylindrical, attenuating slightly posteriorly. Belly laterally angulate. Tail about one-fifth to one-sixth the total length.

Identification.—The costals in 17 rows two heads-lengths behind the head and at midbody, 15 two heads-lengths before the vent; the loreal touching the internasal, and the angulate ventrals will establish its identity. Variety *oligozonatus* bears a superficial resemblance to the other two Ceylon species of this genus, and also to the Ceylon krait, *Bungarus ceylonicus.*

Colouration.—This is a very variable snake, and as a result has had many christenings. From an examination of well over two hundred specimens, from widely separated localities in India, Burma, Ceylon, and the Andamans, I notice that every degree of variation is to be found between specimens that have no dorsal markings, not even a collar, and those that have a complete series of crossbars from the neck to the tail tip. I can recognize only two varieties that I consider deserve the name.

Variety (*a*) *Typica* (Linné).—In this the ground colour varies from a light brown to a tone approximating to a dark cigar. The body is crossed by bars, which are yellow in life,

but which become whitish after a few hours in spirit. There is usually a collar of the same hue. The bars may be present in the whole length of the snake, or may be few, and confined to the anterior region of the body. In some examples they are completely absent, and it is to these uncommon examples that Boie applied the name *unicolor*, and Theobald *hypsirhinoides*. The bars expand in the flanks, and often enclose islets of the ground colour. Those in the anterior part of the body are best defined, and as one proceeds backwards there is a tendency for them to disintegrate more and more, until in some specimens one sees them reduced to a reticulate pattern.

In most specimens from 9 to 18 bars may be counted in the anterior half of the body, and about 5 to 10 scales are involved vertebrally in the first intervals. The lips may be mottled with brown, exhibit central brown islets, or be immaculate. *Typica* is the common variety seen in the whole range of its distribution.

(*b*) Variety *oligozonatus* (Wall).—In this the ground colour is always a dark brown. The crossbars are white, fewer in number, and usually very well defined, and distinct in the whole body length. They number from 3 to 6 on the anterior half of the body, and the most anterior interval involves from 12 to 22 scales vertebrally. I have only seen it in Southern India, and it is far less common than variety *typica*. It is the common up-country form in Ceylon, Mr. Drummond-Hay informs me. In both varieties the under parts are immaculate and pearly-white, sometimes with a pinkish tinge.

Habits.—(*a*) *Haunts*: Of all snakes that seem to seek out and profit by a human environment, the common wolfsnake is the most conspicuous. I should think that fully half the snakes met with inside habitations throughout India would prove to be this species, and it certainly is far more frequently encountered inside bungalows and outhouses than outside them. Not only is it a very frequent tenant of houses, such as those occupied by the European population in cantonments, but it frequently obtrudes itself into densely populated parts, such as bazaars, native towns, jails, &c., and is no rarity in the business quarters of our large Indian cities. I not infrequently have one brought in from the regimental lines, bazaars, and

jails, and have had it from inside regimental and cantonment hospitals. Mr. Millard tells me he has "frequently had specimens sent to the Museum which have been killed in houses in the Fort at Bombay." Like many other snakes, it likes to insinuate itself into the crevices of loose brickwork, such as the foundations and walls of buildings. Here it conceals itself during the day, emerging at nightfall in quest of food. Along the outer walls skirting the jail at Cannanore I rarely passed without finding the sloughs of this snake issuing from holes in the face of the masonry, and have often found it in similar situations elsewhere.

When not established in the safe quarters offered by masonry or a hole in the ground, it coils itself during the day in any convenient dark shelter, beneath the boxes or stores, or among the packages on the shelf in one's storeroom, beneath the discarded bucket or basket behind the stable, beneath one of the flower pots standing in the verandah, in a heap of kunkur beside the road, or stack of bricks or wood, behind or beneath the piles of plant stored in the supply and transport godowns or the Telegraph Office compound, anywhere, in fact, that offers a convenient refuge. In such situations, besides enjoying the semi-darkness so grateful to its tastes, it is brought into convenient association with the very creatures upon which it is wont to prey, the agile but incautious mouse, the slippery skink, and the defenceless little gecko.

(*b*) *Disposition:* The common wolfsnake is a very lively little customer, which usually, on being discovered, slips away hastily if circumstances permit. If pursued, or any attempt made to catch it, or obstruct its path, it strikes out boldly without hesitation, planting its teeth into whatever thwarts its progress, and I have been bitten many times in trying to effect its capture. If in the open, and baulked in its endeavours to escape, it will frequently coil itself into a heap and remain stationary; and if worried, will hide its head beneath its coils. Often, too, while lying thus, it fixes its coils rigidly, so that one can toss it into the air without it releasing its folds, as one might do a piece of knotted cane. A visit paid to such a specimen in its cage an hour or so later will probably show its courage restored, and it will inflict or endeavour to inflict

a wound. Like most other snakes, however, it soon gets accustomed to being handled, and will then suffer itself to be withdrawn from its cage without anger, though it usually struggles to elude one's grasp. Mr. F. Gleadow tells me he "saw one in a climber in his verandah one night, and while examining him to see whether it was a *Lycodon* or a *Bungarus*, with the aid of a hurricane lamp, he let out at me like lightning and scratched my nose. It was a very smart stroke indeed. Nobody had touched him." Gunther says of it: "It is of fierce habits, and defends itself vigorously." Mr. Millard writes to me: "It is of a somewhat fierce disposition, and when first caught will usually turn and bite freely." Colonel Dawson, too, in a letter to me, remarks on the fierceness of its nature.

Mice not infrequently fall victims to this snake, a fact which in itself speaks more eloquently than any remarks can do for the intrepid nature of such a diminutive reptile. Mice, or at least individuals amongst them, are formidable antagonists for small creatures to encounter, and I have collected several interesting records showing that a single one will not only defend itself against the snake or snakes into whose cage it has been put as food, but will sometimes actually turn the tables, fight, overpower, and devour the snake.

(*c*) *Striking Posture:* From a coiled attitude it will frequently strike out vehemently and without hesitation at the object of its fury, and is often a difficult snake to capture without being bitten.

(*d*) *Nocturnal or Diurnal:* It exhibits very decidedly nocturnal propensities. At night the wolfsnake emerges from its fastness, and actively pursues its quest for food. The servants are apt to encounter it in the verandah when serving dinner, the inmates of a house in any of its rooms, the *mem-sahib* in her storeroom, the Sepoy in his lines, the soldier in barracks, and the warder going his rounds in the jail. Mr. Green notes that in captivity it sleeps all day and refuses food, but becomes restless at nightfall.

(*e*) *Progression:* It is a very active little snake that usually makes a bold attempt to retain its liberty, and can move rapidly. Its climbing accomplishments are very remarkable,

for it often puzzles one to know how it can have got on to some of the places from which one dislodges it—the top of a window ledge, the jilmils of a door, the top of the lintel of a door which has become loosened from the masonry, a punkah pole, or curtain rod. Often, too, it will drop from the roof into the verandah amid the family circle, from the covered way to the kitchen, or from the disused punkah pole or cross-bar supporting curtains in the drawing room. I have frequently had opportunities of observing this snake climbing, and find that it can do so with comparative ease even on a vertical plane, especially if the surface is a little rough. Thus, I have many times witnessed it climb up the perpendicular wooden faces of its boxes, the boards being rough from the saw. It clambers with ease, throwing itself into an S-shape, and appearing to balance itself on its tail. As one watches this performance one wonders at the support derived from the tail, expecting every moment to see the snake fall, but no. The caudal extremity resting on the horizontal surface grows less and less, and finally follows the rest of the snake, which adheres vertically wholly unsupported. Now some observers would have us believe that the force which operates in this acrobatic performance is brought about by a muscular effort on the part of the snake, which retracts its abdomen in such a way as to create a vacuum in its body-length, apposed to the surface it is climbing. This, as in the case of an india-rubber cup which has been pressed to exhaust the air, adheres mechanically by the production of a vacuum. I happen on more than one occasion to have seen *Lycodon aulicus* moving up the glass face of its cage; it can do so in a wonderful manner till nearly all the body-length has left the floor, but though I have specially looked for it, I have never been able to see the slightest indication of the muscular action referred to above, but have noticed that the whole surface of the abdomen lay pressed against the glass. I have never seen the snake completely succeed in scaling a face of glass, except in the case of two hatchlings that I put into spirit. To my amazement I found one of these still wet from its immersion lying along the face of the jar above the level of the fluid, and here it maintained a firm attachment, so firm, indeed, that it

almost supported the second one in its endeavours to reach a similar position and escape its fate. In this case also I specially noted that there was no attempt at any retraction of the abdomen. The jar in which this scene was enacted is some 5 inches in diameter, so that the curvature of the glass can have been little assistance to a creature little over 7 inches in length. The wolfsnake appears to me to climb by the aid of its ribs and the free borders of its belly shields, and with these alone. Mr. Sinclair remarked upon one he saw scaling a chick stretched vertically and lashed in position. He says: "The snake evidently climbed by hitching the edges of the ventral shields on to those of the bamboo lattice of the blind and not by winding his body, which was entirely on the side of the blind next to me, round the bamboos." As already stated, it will frequently climb up into the roofs of houses, but, perhaps, the most remarkable example of its scansorial achievements is that mentioned by Haly, a specimen having been caught in the lantern of the Minicoy lighthouse in Ceylon.

Food.—*L. aulicus,* whilst showing a preference for lizards of the gecko family, accepts with avidity other small creatures that cross its path. I have on thirteen occasions known it take geckoes, always of the Genus *Hemidactylus,* usually *frenatus,* but also *coctæi.* On many occasions a mouse had furnished the meal, and on other occasions skinks had been devoured, in the United Provinces *Mabuia dissimilis* (?), in Burma *Lygosoma cyanellum,* and once another *Lygosoma,* too digested to determine. Mr. E. E. Green tells me in Ceylon he has known it take a *Lygosoma* in captivity. Willey says its staple food in Ceylon consist of the Brahminy lizard, *Mabuia carinata.* I have known a frog taken at least on one occasion.

(*f*) *Sloughing:* Mr. Green tells me that a specimen of his in captivity sloughed on March 30, June 21, 1909, and March 17, 1910.

Foes.—I have known it fall a victim to the common krait, and the habits of the two snakes are so alike that I suspect the wolfsnake very frequently meets an untimely death at the jaws of its ophiophagous relative.

Breeding.—(*a*) *The Sexes:* As already remarked, the female appears to grow to a greater length than the male. The sexes, as regards numbers, appear to be equally balanced ; thus, my note books show that of 73 specimens sexed, 36 were males, 37 females. It is evident that after mating the pair do not dissolve partnership for a long time, if they do so at all, for heavily egg-bound females have been found in company with a male. I have found the anal glands, which are supposed to be connected with the sexual functions, active in both sexes, and at every period of the year. The secretion is custard-like in colour and consistency. The copulatory male organs are beset with many minute re-curved spines, and are not bifid.

(*b*) *Method of Reproduction:* It is known to be oviparous in habit.

(*c*) *Season:* I have known the sexes in company in November in Cannanore by report. In this case the native who brought the male assured me it was united with another which escaped. In January, in Fyzabad, two were found in company in a storeroom ; and in Dibrugarh two pairs were killed in company, one in June and one in July. The June female was heavily egg-bound at the time, but only the anterior half of the July specimen,which I assume to have been a female, was brought in, the male being perfect. I have had many females brought to me gravid, all, with one exception, during the first seven months of the year. The one exception was egg-bound in Rangoon on December 20. Of the rest, one in Cannanore was gravid on January 20 ; three in Cannanore in February ; one in Cannanore and two in Fyzabad in March ; one in Cannanore, two in Fyzabad, and five in Dibrugarh in April ; one in Cannanore and three in Dibrugarh in May ; one in Cannanore and one in Fyzabad in June ; and three in Fyzabad in July. The eggs are deposited in the months from February to July. A clutch of ten eggs on the point of hatching were dug out of an anthill on February 20, 1920, at Anasigalla, Kalutara District. One laid five eggs in the Madras Museum on March 29, 1919.

(*d*) *Period of Gestation:* Not known.

(*e*) *Period of Incubation:* Not known.

(*f*) *The Eggs:* The eggs vary in number from three to eleven, but are usually from four to seven. They are elongate white ovals, equally domed at each pole, and soft to the touch, the shell resembling white kid until vacated, when it dries and hardens into a somewhat crisp parchment-like envelope. When seen *in abdomina* they are frequently, but by no means always, particoloured, gray and white. The gray colour appears to me to be due to absorption of colouring matter from the intestine, for it is always seen on that part of the shell which lies in contact with the gut, is absent when the gut is empty, and present in some eggs in the chain corresponding to a loaded part of the intestine. It may be originally derived from the pigment in the skins of the creatures ingested. When laid the gray colour is never visible as far as I am aware. The deposited eggs in one clutch varied from 25 to 32 mm. (1 to $1\frac{1}{4}$ inches) in length, and 9 to 12 mm. ($\frac{3}{8}$ to $\frac{1}{2}$ an inch) in breadth. The shortest eggs are decidedly broader than the most elongate. I have removed larger eggs from the abdomen, where I found them up to 42 mm. ($1\frac{5}{8}$ inches) long. At the time of deposition they contain minute embryos. These are difficult to discover. The best means to do so is to slit the egg carefully with scissors, and allow the contents to float out into a basin of water, doing all manipulations subsequently with a very soft camel-hair brush.

Growth.—(*a*) *The Hatchling:* These escape from the egg by means of the fœtal tooth, though I have failed to find it in the many examples I have examined. The appearance of the eggs after evacuation is similar to that seen in other species. A clutch of five was brought to me once, which had been found in a planter's bungalow. A single hatchling was present with the eggs, all of which, except a non-fertile one, were empty.

The young when they escape from the egg vary in length from $6\frac{3}{4}$ to $7\frac{3}{4}$ inches, or about one-third the length of a large adult. They are exactly like most adults in colour and markings. I have seen two of the same brood, one with very distinct yellow bars, in the whole body length, whilst the other had a few rather obscure bars anteriorly only. One of these was very vicious, and bit me more than once when handling it. It attacked, killed, and soon swallowed a young gecko I gave it.

(*b*) *Early Life:* It is very difficult to follow the growth after the second year from the figures to hand in my note books. It is certain, however, that when one year old the young have at least doubled their length, being over 1 foot 1½ inches long, but they hatch over such a long period of the year that the lengths become hopelessly mixed, leaving no gaps to indicate successive broods. A large number of specimens between 1 foot 6 inches and 1 foot 8 inches in length at the same period of the year seems to indicate that this length is reached at the end of the second year of life.

(*c*) *Maturity:* The smallest gravid females I have known were both 463 mm. (1 foot 6¼ inches) long, a length indicating that they were about two years old.

(*d*) *Maximum Length:* It grows to about 765 mm. (2½ feet), but specimens over 610 mm. (2 feet) are uncommon. I have records of over 19 of that length, the largest being females. My biggest male was 692 mm. (2 feet 3⅛ inches), and I have had four females larger, the largest being 737 mm. (2 feet 5 inches). Mr. Millard has given me two records in excess of my figures. One was 800 and another 838 mm. (2 feet 7½ inches and 2 feet 9 inches) long.

Parasites.—(*a*) *Ectozoa:* I have found them occasionally infested with mites. Some of these that I submitted to Professor Nuttall are reported to be larval forms of some undeterminable species, probably a *Gekobia*. An apparently identical parasite is shown in figure 19.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures rather longer than the rest. *Internasals:* The suture between them about two-thirds that between the præfrontals, rather longer than the internaso-præfrontal. *Præfrontals:* Touch the internasal, loreal, præocular, and frontal; the suture between them much longer than the præfronto-frontal. *Frontal:* The fronto-supraocular suture longer than the fronto-parietals. *Nasals:* Small, subequal in depth. *Loreal:* One; touching the internasal, much longer than the nasals. *Præocular:* One; touching or nearly touching the frontal. *Temporals:* Lower, about half the length of the supraocular. *Supralabials:* Nine; the 1st and 2nd touching the nasals, 3rd, 4th, and 5th the eye, and the 6th and 7th the lower

temporal. *Sublinguals:* The pairs subequal; posterior touching the 5th and 6th infralabials. *Infralabials:* Six, the 6th about as long as the posterior sublinguals, and about twice as broad; touching three scales behind. (Fig. 34.)

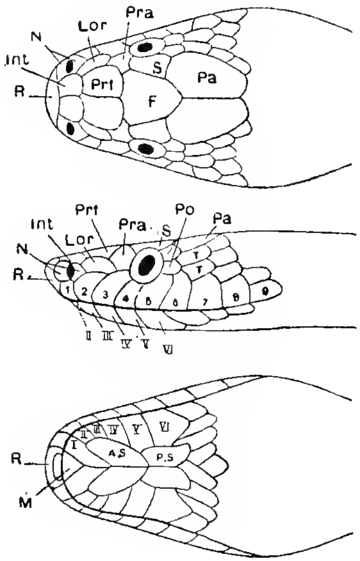

FIG. 34.—Lycodon aulicus.

(Natural size.)

Costals: Vertebrals nearly as broad as long, three-fourths the breadth of the ultimate row. Last three or four rows increasing in breadth. Ultimate row as broad as long. In 17 rows two heads-lengths behind the head, 17 at midbody, and 15 two heads-lengths before the vent; the reduction in

rows occurs shortly behind midbody, and is due to the absorption of the fourth row from the ventrals. *Ventrals :* Laterally angulate ; 170 to 224. *Anal :* Divided. *Subcaudals :* Divided ; 56 to 80.

(*b*) *Anomalies—Nasals :* Sometimes touch the 1st only of the supralabials. *Loreal :* Rarely divided into an anterior and a posterior part. *Postoculars :* Rarely three. *Temporals :* Rarely three. *Supralabials :* Two shields are sometimes confluent, making eight, or a supernumerary may be present making ten. In the former case the 3rd and 4th only may touch the eye, and in the latter the 3rd, 4th, 5th, and 6th. *Anal :* Rarely entire. *Subcaudals :* Sometimes a few near the base of the tail are entire.

Dentition.—From seven skulls in my collection. *Maxillary :* Prænodal 5 ; the anterior three progressively increasing in length, the last two subequal, and about twice the length of the third. Postnodal 8 to 12. Cranterian 2 ; about twice the length of the preceding. *Palatine :* 10 to 15. *Pterygoid :* 18 to 25. *Mandibular :* Prænodal 5 ; the anterior three progressively increasing in length, the last two subequal, and about twice the length of the third. Postnodal 13 to 19 ; small and subequal. (Fig. 35.)

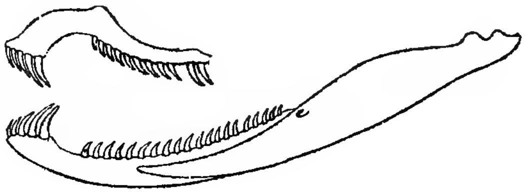

FIG. 35.—Jaws of Lycodon aulicus.

Maxilla above.

Mandible below.

Distribution.—(*a*) *General:* Peninsular India to the Himalayas, and as far as the Punjab in the north-west. Bengal, Assam, Burma, Indo-China, the Malay Peninsula, the Malay Archipelago to the Philippines, Ceylon, the Maldives, Andamans, and Nicobars.

(*b*) *Local:* It is an extremely common denizen of the plains, but I have met with it in the Himalayas up to 5,000 feet. Willey says in Ceylon it does not appear to ascend above 3,000 feet. Mr. Drummond-Hay tells me he never obtained a single specimen at Hopewell estate, Balangoda district (3,000 to 4,200 feet).

* Cercaspis carinatus Kuhl.

(Latin "carinatus" keeled.)

The Ceylon Wolfsnake.

Synonymy.—*Hurria carinata, Lycodon carinatus.*

History.—Described by Kuhl in 1820.

General Characters.—Grows to over 2 feet. Head pear-shaped. Snout much depressed, moderately-rounded terminally, without canthus. Eye rather small. Neck fairly constricted. Body moderately long, cylindrical, attenuating slightly posteriorly. Belly laterally angulate. Tail short, about one-fifth to one-sixth the total length.

Identification.—The costals 17 two heads-lengths behind the head, 19 in midbody, and 17 two heads-lengths before the vent, will suffice to identify the species among Ceylon snakes. This is one of the few species with entire subcaudals. It is remarkably like the poisonous snake *Bungarus ceylonicus* in colour and markings, and also closely resembles *Lycodon aulicus* and *L. striatus*.

* I have recently communicated a note to Spolia Zeylanica giving my reasons for separating the genera *Lycodon* and *Cercaspis*.

Colouration.—Dorsally it is black, with from 15 to 20 white bands on the body, and 4 to 7 on the tail. These bands involve about two scales vertebrally, expand in the flanks, and continue on to the belly, and are narrower posteriorly than anteriorly. There is a white collar extending to the back of the head in young examples, which disappears as age advances. The belly is black with white bands.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—(*a*) *The Young:* Two specimens, evidently hatchlings (or recently born ?), in the same bottle in Mr. Drummond-Hay's collection measured 182 and 188 mm. ($7\frac{1}{4}$ and $7\frac{1}{2}$ inches) respectively. Unfortunately no date is on record.

(*b*) *Maximum Length:* One in Mr. Drummond-Hay's collection is much the largest on record. This measured 730 mm. (2 feet $4\frac{3}{4}$ inches), the tail being very slightly deficient.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal and rostro-internasal sutures subequal, and larger than the rostro-labials. *Internasals:* The suture between them half or less than half that between the præfrontals, rather shorter than the internaso-præfrontals. *Præfrontals:* Touch the internasal, postnasal, loreal, præocular, supraocular, and frontal; the suture between them much longer than the præfronto-frontal. *Frontal:* The fronto-supraocular sutures subequal to the fronto-parietals. *Supraoculars:* Length three-fourths the frontal, about half the parietals, breadth about half the frontal along a line connecting the centres of the eyes. *Nasals:* Divided, the postnasal deeper than the anterior. *Loreal:* One, about as long as the nasals, not touching the internasal. *Præocular:* One, not nearly reaching the frontal. *Temporals:* Two, the lower about half the length of the supraocular. *Supralabials:* Nine; the 1st and 2nd touching the nasals; 3rd, 4th, and 5th the eye; and the 5th, 6th, and 7th the lower temporal. *Sublinguals:* The pairs subequal; the posterior touching the 5th and 6th infralabials. *Infralabials:* Six; the 6th nearly as long as the posterior

sublinguals, and about twice as broad; in contact with three scales behind.

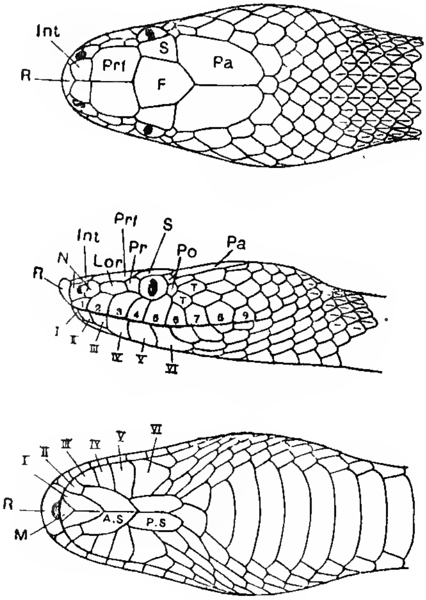

FIG. 36.—Cercaspis carinatus.
(× $\frac{3}{4}$)

Costals: All rows keeled posteriorly. *Vertebrals:* Breadth rather less than their length, about three-fourths to four-fifths that of the ultimate. Ultimate row enlarged, the scales as broad as long. In 17 rows two heads-lengths behind the head, 19 at midbody, and 17 two heads-lengths before the vent. The increase of rows occurs four or five heads-lengths behind the head, and is due to the division of the fourth row from the ventrals. The reduction occurs four or five heads-lengths before the vent, and is due to the absorption of the fourth or fifth row above the ventrals. *Ventrals:* 185 to 202; angulate laterally. *Anal:* Entire. *Supracaudals:* In odd rows; keeled to the tip of the tail. *Subcaudals:* 51 to 64; entire.

(*b*) *Anomalies—Temporals :* Sometimes three. *Supralabials :* Sometimes two are confluent to make eight.

Dentition.—From one skull in my collection. *Maxillary :* Prænodal 5, the anterior 3 progressively increasing the 4th and 5th subequal, and twice as long as the 3rd. Præcranterian 7 to 8, small, subequal. Cranterian. 2, subequal, nearly twice the preceding. *Palatine :* 13 to 14. *Pterygoid :* 27 to 29. *Mandibular :* Prænodal 4, the 3rd and 4th subequal, twice the length of the 2nd. Postnodal 13, small, subequal.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* There are very few records of this snake. The British Museum collection contains eight, and the Colombo Museum but one. Mr. Drummond-Hay, however, tells me he found it a common snake at Hopewell estate, Balangoda district (3,000 to 4,000 feet), and also at Galatura, Ratnapura District (500 to 1,000 feet). Haly records it from Jaffna, and Abercromby, with a doubt, from Matale. I have had one from the Ratnapura District. It would appear from these records to be a low-country species ascending into the low hills.

Genus DRYOCALAMUS.

(Greek " drus " a tree, and " kalamos " a pen.)

General Characters.—Small snakes only growing to about 18 inches. Head oval in outline, broadest midway between the eye and the neck, considerably depressed. Snout rather short, narrowing to an obtuse extremity, without canthus. Eye large, with vertical pupil. The iris is quite black, and the shape of the pupil cannot be seen in life. Nostril small, lateral. Neck fairly evident. Body elongate, cylindrical, slender, of even calibre throughout. Belly laterally angulate. Tail short, being about one-fifth the total length.

The species show a considerable resemblance to those of the Genus *Lycodon* in superficial characters, but the dentition shows that they are not very closely related.

Identification.—Costals as broad as long in 13 or 15 rows in the whole body length will establish the genus.

Habits.—Terrestrial, with clambering propensities. Nocturnal. Active. Fierce on provocation.

Food.—Chiefly lizards ?

Breeding.—Nothing known.

Poison.—Not poisonous.

Lepidosis (for Indian species).—*Rostral:* Touches six shields. *Internasals :* A pair. *Præfrontals :* A pair. *Nasals :* Semidivided. *Loreal :* One, touching the eye. *Præocular :* Absent or present. *Postoculars :* Two. *Temporals :* One or two. *Supralabials :* Seven. *Sublinguals :* Two pairs, subequal or the anterior longer.

Costals : As broad as long, rectiform, smooth, with single apical pits. Vertebrals not enlarged. Ultimate row very slightly enlarged. In 13 or 15 rows at midbody. *Ventrals :* Laterally angulate. *Anal :* Entire or divided. *Subcaudals :* Divided.

Dentition.—*Maxillary :* Syncranterian, anododont, isodont. *Palatine :* Anododont, isodont. *Pterygoid :* Anododont, isodont. *Mandibular :* Anododont, feebly scaphiodont.

Distribution.—South-eastern Asia.

There are five species, of which two occur in Ceylon, viz., *nympha* and *gracilis.*

DRYOCALAMUS NYMPHA Daudin.

(Latin " nympha " a bride. The yellow mark on the back of the head suggests a bridal veil.)

The Bridal Snake.

Synonymy.—*Coluber nympha, Lycodon nympha, Odontomus nympha, Hydrophobus semifasciatus, Odontomus semifasciatus, O. nympha, Hydrophobus nympha.*

History.—Introduced to scientific knowledge by Russell in 1796 and figured twice in his first volume. Daudin christened the snake in 1803.

General Characters.—As detailed under the genus.

Identification.—The costals in 13 rows in the whole body length, taken with the elongate loreal touching the eye, suffice to distinguish this from all other Ceylon colubrines.

Colouration.—Lustrous dark brown or blackish-brown dorsally, fading somewhat posteriorly. There are from 35 to 50

conspicuous white or yellowish-white crossbars on the body and tail, more conspicuous and more widely placed anteriorly. There is a similar bar on the back of the head. The ventrum is uniform pearly-white, creamy, or yellowish. It is a remarkably handsome little reptile.

Habits.—(*a*) *Haunts :* Most of the specimens that have come into my hands have been found inside bungalows. One came right under a friend's chair after dinner one night. Others sent to me were either found in the house or about the pot plants.

Dr. Henderson tells me that when captured it has a curious habit of twisting itself into knots. Abercromby mentions finding one in his bath.

(*b*) *Disposition :* I know nothing of this snake in life.

(*c*) *Nocturnal or Diurnal :* The vertical shape of the pupil indicates a nocturnal habit, and this is borne out by actual experience.

(*d*) *Progression :* One I tried to kill was wonderfully active, and managed to evade several strokes I aimed at it. It climbs well, and not infrequently falls, or is dislodged from the roofs of houses where it has taken up quarters.

Food.—I have no records of this, but Dr. Henderson tells me that he once found a skink (*Mabuia carinata*) in the stomach of one.

Breeding.—Nothing known.

Growth.—The smallest specimen I have had, and a hatchling I believe, was between 4 and 5 inches in length. Date of capture not on record. My largest specimens were 520 mm. long (1 foot 8 inches).

Lepidosis.—(*a*) *Typical—Rostral :* The rostro-nasal sutures rather shorter than the rostro-internasal, and nearly twice the rostro-labials. *Internasals :* The suture between them equal to, or rather shorter than that between the præfrontals, half to two-thirds the internaso-præfrontals. *Præfrontals :* Touch the internasal, postnasal, loreal, præocular, and supraocular; the suture between them subequal to the præfronto-frontal. *Frontal :* The fronto-supraocular sutures twice the fronto-parietals. *Supraoculars :* As long as the frontal, half to two-thirds the breadth of the frontal along a

line connecting the centres of the eyes. *Nasals :* Semi-divided or entire, the nostril in the median third of its depth. *Loreal :* One, not touching the internasal ; touching the eye ; as long as or longer than the nasal. *Præocular :* One. *Postoculars :* Two. *Temporals :* Two, the lower half to three-fifths the length of the supraocular. *Supralabials :* Seven, the 1st and 2nd touching the nasals, 3rd and 4th the eye, and 5th and 6th the lower temporal. *Sublinguals :* Two pairs, the posterior touching the 4th and 5th infralabials. *Infralabials :* Five, the fifth twice as broad as the posterior sublinguals, and about as long ; touching three scales behind.

Costals : As broad as long. In 13 rows in the whole body length. *Vertebrals :* 200 to 243 ; angulate laterally. *Anal :* Divided. *Supracaudals :* In even rows. *Subcaudals :* 65 to 88 ; divided.

(*b*) *Anomalies—Nasals :* Sometimes divided. *Præocular :* Rarely absent. Sometimes two (Boulenger). *Supralabials :* Sometimes six or eight. *Subcaudals :* Some near the base of the tail, occasionally entire.

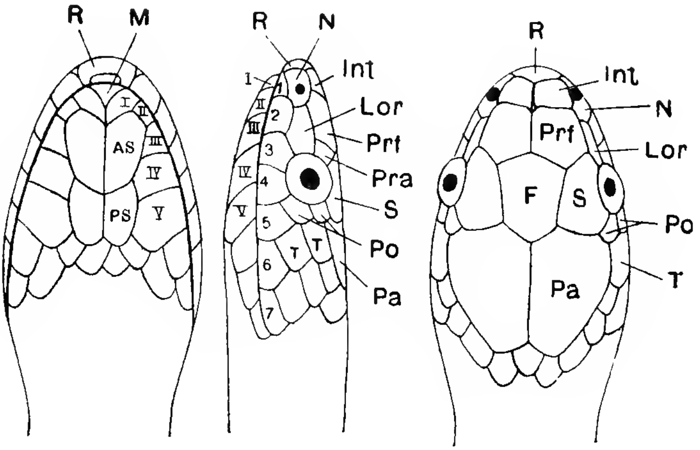

FIG. 37.—Dryocalamus nympha.

(× 3.)

Dentition.—From two skulls in my collection. *Maxillary:* 9 to 10, compressed. *Palatine:* 8 to 9; very small, about half the length of the maxillary. *Pterygoid:* 20 to 21; longer than the palatine. *Mandibular:* 19 to 21.

Distribution.—(*a*) *General:* South India as far north as Orissa (Chilka Lake and Berhampore); Ceylon. Haly says the 5 specimens in the Colombo Museum in his day were from Jaffna, and Willey mentions it from Anuradhapura. Ferguson speaks of one from the south part of the Island without specifying further. One in the British Museum is labelled Trincomalee.

(*b*) *Local:* It is a denizen of the plains, but ascends some altitude into the hills. In South India it is rather an uncommon snake, and it appears to be equally uncommon in Ceylon. Mr. Drummond-Hay tells me he has never met with it.

Dryocalamus gracilis Gunther.

(Latin " gracilis " graceful.)

The Scarce Bridal Snake.

Synonymy.—*Odontomus gracilis, O fergusoni, Hydrophobus gracilis.*

History.—Described by Gunther in 1864.

General Characters.—As detailed under the genus.

Identification.—The costals about as broad as long, and in 15 rows in the whole body length will identify it. The costals in 15 rows in the whole body length, and a loreal touching the eye, when taken together will establish the identification.

Colouration.—It is exactly like *nympha* in every way. The eye, too, in life is similar.

Habits.—(*a*) *Haunts:* Appears to be similar to *nympha.* It frequents houses, and climbs into the roof. One specimen I had (Berhampore, Orissa) fell from the roof into the middle of a family circle after dinner.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—My two specimens were 570 and 619·5 mm. (1 foot 10, and 1 foot 11⅞ inches), respectively.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-internasal sutures rather longer than the rostro-nasal. *Internasals:* The

suture between them subequal to that between the præfrontals, subequal to the internaso-præfrontals. *Præfrontals:* Touching the internasal, postnasal, loreal, præocular, and supraocular; the suture between them subequal to the præfronto-frontal. *Frontal:* The fronto-supraocular sutures longer than the fronto-parietals. *Supraoculars:* As long as the frontal, and about half its breadth along a line connecting the centres of the eyes. *Nasals:* Semi-divided or divided. *Loreal:* One, about as long as the nasals; not touching the internasals, touching the eye. *Præocular:* One, above the loreal. *Postoculars:* Two. *Temporals:* Two; lower much shorter than the supraocular. *Supralabials*. Seven; 1st and 2nd touching the nasals, 3rd and 4th the eye, and 5th and 6th the temporal. *Sublinguals:* Posterior rather shorter than the anterior; touching the 4th and 5th infralabials. *Infralabials:* Five; the fifth twice as broad as the posterior sublinguals, and about as long; touching three scales behind.

Costals: About as broad as long. In 15 rows in the whole body length. *Ventrals:* Angulate laterally, 199 to 243. *Anal:* Entire. *Supracaudals* · In even rows. *Subcaudals:* Divided, 75 to 87.

(*b*) *Anomalies—Præocular:* Rarely absent.

Costals: These scales in a specimen in the British Museum from the Anamallay Hills are in 13 rows to about four heads-lengths behind the head. Here the row next to the vertebral divides, and the scale rows become the normal 15. In another specimen in the British Museum from Cuddapah I find the scale rows 13 to about midbody, when the row next to the vertebral divides and so the normal 15 rows are established. The two rows thus formed re-unite and re-divide several times making the count alternately 13 and 15, *Anal:* Rarely divided. A specimen in the Indian Museum (No. 8,690 of Sclater's catalogue 1891, and referred by him to *davisoni* (Blanford)) from False Island Arrakan coast has 15 scale rows in the whole body length, ventrals 237, anal divided and subcaudals 86, one præocular above the loreal, and the loreal touching the eye. I think there in every reason to doubt the locality given as this is not a Burmese snake.

Dentition.—I have no skull.

Distribution.—(*a*) *General:* South India as far north as Orissa ; Ceylon.

(*b*) *Local:* Anamallay and Cuddapah Hills (Beddome's specimens in the British Museum). I have had two from Orissa, and Elliot refers to one killed at Waltair. Haly refers to two from Ceylon without specifying the localities. Mr. Drummond-Hay tells me he has never obtained a specimen. Evidently very uncommon in Ceylon as well as in India.

Genus ZAOCYS.

(Greek " za " very, " okus " swift.)

General Characters.—For Indian species. Large snakes, some attaining to over 6 feet in length. Head ovate, moderately depressed. Snout rather long, narrowing to a rather subacute extremity ; with an obtusely rounded canthus. Loreal region concave. Eye, rather large, with iris speckled with gold, and round pupil. Nostril large, occupying the full depth of the suture between the nasals. Neck fairly constricted. Body elongate, robust, distinctly compressed, attenuating to the neck, and posteriorly. Belly laterally obtusely angulate. Tail long, being about one-fourth to nearly one-third the total length.

Identification.—The only snakes with the scale rows in even numbers on the body. In most of the species the vertebral row is absorbed in the neck into the uppermost row on the left side. In *mucosus* this absorption does not occur until behind midbody.

Habits.—Terrestrial. Diurnal. Active and strong. Fierce when provoked.

Food.—Mammals, birds, lizards, batrachians.

Breeding.—Oviparous.

Poison.—Non-poisonous.

Lepidosis.—*Rostral:* Touches six shields. *Internasals:* A pair. *Præfrontals:* A pair. *Nasal:* Divided. *Loreal:* One to three. *Præoculars:* One. *Postoculars:* Two. *Temporals:* Two. *Supralabials:* Eight. *Sublinguals:* Two pairs, the posterior longer.

Costals: Longer than broad, keeled in the median rows ; with double apical facets ; the median and last two rows

rectiform, the 3rd to 7th from the ventrals slightly oblique. Vertebrals, where the rows are odd, slightly enlarged. Last two rows enlarged. *Ventrals :* Obtusely angulate laterally. *Anal :* Divided. *Supracaudals :* In even rows. *Subcaudals :* Divided.

Dentition.—*Maxillary :* Syncranterian, anododont, coryphodont. *Palatine :* Anododont, feebly kumatodont. *Pterygoid :* Anododont, isodont. *Mandibular :* Anododont, feebly kumatodont.

Distribution.—South Eastern Asia.

There are seven species, one of which, viz., *mucosus*, occurs in Ceylon.

ZAOCYS* MUCOSUS Linné.

(Latin " mucosus " slimy.)

The Dhaman,† or Common Ratsnake.

Tamil : " saray pambu " (straight snake). The natives say it takes a direct bee-line from danger.

Sinhalese : " garandiya " (Willey).

Synonymy.—*Coluber mucosus, C. dhumna, C. blumenbachii, Natrix mucosa, Coryphodon blumenbachii, Leptophis trifrenatus, Ptyas mucosus.*

History.—First brought to notice, and christened by Linné in 1766. Russell figured it in his first volume (Plate XXXIV.) in 1796, and again in his second volume (Plate XVIII.) in 1801.

General Characters.—A formidable snake, growing to over eight feet in length. Head rather long. Snout longish, canthus obtuse, somewhat narrowly rounded. Eye large. Nostril large, occupying the whole depth of the suture between the nasals. Neck distinctly constricted. Body

* This snake was placed by Boulenger in the Genus *Zamenis*. Some time ago I pointed out that its affinities are closer to *Zaocys* than *Zamenis*. In all the species of *Zaocys* the costal rows are in even numbers, and in the species I have examined there is an absorption of the vertebral row in the neck, into the uppermost row on the left side. In *mucosus* precisely the same absorption occurs, but behind midbody instead of in the neck, and the rows then are even in number. Boulenger says of the maxillary dentition that in *Zaocys* the teeth number 20-33 and in *Zamenis* 12 to 20. In the six skulls of *mucosus* in my collection the *maxillary* teeth vary from 20 to 24, so that in this important character also the species conforms more to the dentition of a *Zaocys* than to a *Zamenis*.

† " Dhaman " is the Sanskrit word for rope.

robust, distinctly compressed, attenuating anteriorly and posteriorly. Belly obtusely angulate laterally. Tail cylindrical and long, being about one-fourth the total length.

Identification.—The costals are 17 two heads-lengths from the head, 17 in midbody, and 14 or 12 two heads-lengths before the vent. This will suffice to declare its identity. It is the only Colubrine Ceylon snake with three loreals.

Colouration.—The prevailing hue on the head and body, including the tail, is dorsally an olivaceous-green, or olivaceous-brown. In the anterior half, or three-fifths of the body length, this is uniform or nearly so, but in the posterior part many scales are irregularly margined with black, so as to form a reticulate pattern with a tendency to form crossbars. Individuals differ in colour ; I have seen some as yellow as mustard and others of a hue as dark as sepia. The shields bordering the lips, the scales at the side of the throat, and the scales beneath the body, and tail are more or less margined posteriorly with black ; in fact, these marks form a very characteristic trait in the physiognomy. On the belly the regularity of the black marks forcibly reminds one of a tape measure, but in individuals, they may be reddish or absent in whole or in part. The belly is grayish-white, dirty-white, or yellowish, the latter hue often more pronounced about the throat. The skin dorsally is blackish, mottled with fawn, or whitish in irregularly transverse streaks, but this is usually not seen owing to the overlapping of the scales. The overlapped margins of the scales, however, partake of this cutaneous colouration, and in young specimens light, bluish-gray, irregular crossbars are usually conspicuous, especially anteriorly. In young the prevailing colour is often more grayish or bluish than one sees in the adult, but the markings and general appearance are very closely similar.

A peculiarly light specimen approaching to an albino is recorded by D'Abreu in Volume XXV., page 753, of the Bombay Natural History Journal, and accorded the rank of a variety under the name *pallidus*. I think it is a freak, lacking the usual pigmentation of this species.

Habits.—(*a*) *Haunts :* There is scarcely a situation, whether in hill or dale, forest or plain, arid, swampy, or cultivated tract,

tree, bush, or habitation in which it may not take up its abode. It is quite at home in the proximity of man, and is to be met with in the gardens of populated areas within our largest cities almost as plentifully as in the more tranquil quarters of the country. In such localities, in deference to man's hostile inclinations, it is forced to retire during the day into some secure retreat, commonly taking up its abode in an anthill, drain, or other convenient hole in the compound, or even in the outhouses, or bungalow itself. Like other snakes, it loves old masonry, and is often flushed from, or seen retiring into, the crevices and crypts furnished by old walls or brick wells. In Rangoon, with the aid of a bicycle lamp to illuminate the gloom of the little galleries left for drainage purposes in the faces of the fort walls, I frequently found one coiled up, and provoked it to a speedy exit. In the bungalow it may tenant the basement, but not infrequently finds its way up into the roof, where it may reside above the ceiling cloth, and though few may deem it as such, it is certainly entitled to the consideration of a welcome friend. The late Chaplain of Cannanore, the Reverend R. B. Redding, told me that once when in conversation with a lady, upon whom he was calling, a scampering was heard overhead on the ceiling cloth, and a rat fell through a hole on to the floor. It was closely followed by the head and much of the body of a large snake, which, however, managed to withdraw itself. It is more than probable that this was a ratsnake.

Removed from man's immediate environment I believe it realizes there is no occasion for such prison accommodation as populous localities thrust upon it, and here it has free scope to indulge its diurnal inclinations. In Cannanore snipe shooting I very frequently encountered it in broad daylight, leisurely pursuing its quest for luncheon, and when not actually on the move, I often found it coiled asleep in the paludal vegetation, or beneath a bush. Again, on two or three occasions when stepping into paddy fields at dawn, I have seen it coiled up on the heaps of decaying vegetable matter, which represented the remnants of last year's crop and weeds, suggesting that it had taken up these quarters overnight.

It shows a decided partiality for the vicinity of water for reasons very obvious when we come to consider its diet. It will take readily to water should occasion demand, and swims vigorously and well, carrying its head above the surface for choice, but diving when the necessity is urgent.

I have had many killed high up in trees, 20 feet or more, also on the roofs of houses. Mr. Millard tells me he once saw a large dhaman up a wild date palm tree on Malabar Hill, Bombay, and from the excitement shown by the small palm squirrels (*Funambulus palmarum*), there was no doubt what it was after. When I was in Fyzabad a specimen 6 feet 8 inches was brought me, which was discovered high up in a tree, the attention of a passer-by having been called to it by the noisy demonstrations of several birds. I found it contained two large chicks, each 3½ inches long, in the stomach, and a larger one 4 inches long in the gullet. They were partially enveloped in their shells, which were of a uniform bright blue colour. They appeared to me to be much too large for crowchicks, and the colour of the eggs was not corvine. In Almora one discovered in a hollow tree tenanted by a colony of bats was found, when killed, to have eaten six bats.

(*b*) *Disposition:* It is undoubtedly when provoked a very fierce snake, and if brought to bay will assume the offensive with great courage and determination; but this side of its nature is rarely exhibited, as, like other snakes, it prefers to acknowledge man's supremacy by seeking swift escape when this offers. I have many times jumped into the middle of its coils when I have seen it enjoying a siesta, but have never been menaced, or struck at once, the reptile's acknowledgment of the rude awakening being manifested by speedy disappearance. On occasion, however, and specially if reasonable chances of escape are denied, it will attack with great malice. Father Dreckman once chased a specimen nearly 8 feet long, and managed to place his foot over the hole it was making for. Baulked in its attempt to escape, it coiled itself up and jumped straight at his face. Luckily Father Dreckman drew back his head in time to evade a blow in the face, but the reptile fastened itself on to his shoulder with such purpose that its teeth penetrated not only his clothes, but actually lacerated

the skin beneath. On another occasion, when the same observer was rendering assistance to a hatchling which was trying to emerge from its egg, the vicious little creature resenting interference bit him in the finger, and actually drew blood. On one occasion I saw a small one, only 18 inches long, turn when pursued by a terrier and strike most viciously. Mr. Hampton tells me that once when attempting to capture one he found in a drain it struck viciously at him and inflicted a wound beneath one of his eyes. In Bangalore I saw one belonging to a sampwallah strike most vehemently at and bite a mongoose, also one of the stock in trade. Mr. Millard tells me it is a difficult snake to tame when fairly grown, and will attack freely when cornered. Nicholson remarks how it will fight for its freedom, and says it is always a little uncertain to handle in captivity. Gunther says: "It is of fierce habits, always ready to bite, and old examples brought to Europe never become tame."

In Rangoon I had one brought to me which, it was reported, was attacking a full-grown fowl. The few specimens I have had caged exhibited a very nasty temper, and struck out most maliciously at me whenever I approached the glass of the cage; often two or three strokes were delivered in rapid succession and with such force that the creature must have hurt itself considerably. Mr. Millard further tells me that in the Society's cages in Bombay large specimens are so restless when captive, and strike so frequently at the wire netting, that they do not live long.

(*c*) *Striking posture:* The stroke is delivered upwards, as though to wound the face, a peculiarity also noticed by Mr. Millard. When infuriated, prior to delivering its stroke, it retracts the head and forebody into an S, slightly erects itself, and gives vent to a peculiar sound, which I have heard no other snake produce, and which reminds me of the sound made by a cat at bay. Cantor likens it to the sound of a vibrating tuning fork. During the production of this warning note the snake compresses itself anteriorly (*i.e.*, flattens itself in a direction contrary to that manifested by the cobra), the spine being arched about the neck and the throat markedly pouched.

(*d*) *Nocturnal or diurnal:* The dhaman is diurnal in habit. One meets it usually in the daytime in quest of food, and nearly all the specimens brought to me have been killed in daylight. I have frequently observed it methodically prying into places likely to harbour some rat or other creature. When the quarry is flushed the dhaman pursues in hot haste.

(*e*) *Progression:* It appears to be very fleet in its movements, but its speed is deceptive, for on one occasion, when I chased one using its full endeavours to escape, I found I had traversed 38 yards, while the reptile covered 18. It measured 5 feet 9¼ inches. This was in the open. Over rough ground or in jungle I would lay odds on the dhaman if the distances were reversed.

(*f*) *Hissing:* This species not only utters a sibilant hiss, which is clearly audible at close quarters, but under extreme excitement it makes a curious groaning sound, to which I have already alluded.

(*g*) *Sloughing:* Miss Hopley says of a specimen caged at Regent's Park, London, that it cast its skin about once a month.

Food.—The dhaman is very catholic in its tastes, devouring almost anything that chance brings within its reach, but it displays a very marked partiality to a batrachian diet, doubtless because toads, and more especially frogs, are extremely plentiful, easily captured, and too defenceless to offer much resistance. The possibility of taste influencing its selection may be dismissed, since flesh, however toothsome, must fail to impart its relish when clothed in feathers, fur, or integuments. Perhaps, though the texture of these vestments may gratify the mouth or gullet as keenly as the flesh may conciliate the peptic glands. When hunger presses it is stimulated to make full use of its courage, vigour, and speed in shikaring the object of its gastric affections. The incident of the rat falling through the ceiling cloth demonstrates this. Blanford mentions one he saw pursuing a lizard (*Calotes versicolor*) at full speed, which it caught, and then throwing its body over its victim speedily devoured. This practice of holding down its prey when troublesome to manage, or seized

in a position unfavourable for swallowing, is characteristic, and it can exert a very considerable strength in this manner. Mr. Hampton tells me he has seen it hold a rat down with its body, pressing it tightly on the ground, and Mr. Millard gives me a very striking example of this behaviour. He says: "One of these which we were keeping in the same cage as our python recently caught a rat (which was put in for food) by the tail. The rat turned and bit the dhaman severely, and the dhaman killed it by holding on to the tail and pressing the rat against the body of the python and the floor of the cage. Severe pressure must have been brought to bear, as the rat—a full-sized one—was dead in three or four minutes."

Here I may draw attention to the frontispiece of Lyddeker's Royal Natural History, Vol. V., which shows this snake entwined in a most unnatural manner round a perpendicular bamboo stem, a large part of its body free, and holding a large rat with a serenity and facility very unreal. I doubt whether this acrobatic performance is possible for more than a few seconds, apart from the manner in which it is shown bolting its meal. It is regrettable that the inaccuracies of a skilled artist should pass the censorship of so great a naturalist.

The quarry once captured is swallowed at once, so that in the case of inoffensive creatures, such as frogs, it is no unusual circumstance for them to reach the stomach sufficiently alive for their suppressed cries to be distinctly audible; and, moreover, remarkable as it may seem, when rescued from their engulfment, it is a fairly common event for them, after the lapse of some minutes, to recover sufficiently to hop away. I have witnessed this on several occasions, and Kelsall has recorded a similar experience.

Rats, though sometimes preyed upon, are not nearly so staple an article of diet as suggested by its name. Mr. Hampton tells me that in captivity in Regent's Park, London, he was familiar with this snake, and saw it seizing and devouring good-sized rats with avidity, but that his specimens in Burma, far from liking rats, seem to be afraid of them, preferring an exclusively batrachian fare. Lizards, birds, and other small vertebrates form a welcome supplement to its voracity. Recently, in Fyzabad, a three-footer was found in a shrub

attacking a nest of young birds. It had already swallowed a gecko (*Hemidactylus gleadovi*), and was in the act of devouring one fledgling. That it must be considered both gourmand and gourmet may be inferred from the following bills of fare. A specimen brought to me in Cannanore had eaten a large frog (*Rana tigrina*), a large toad (*Bufo melanostictus*), and a half-grown lizard (*Calotes versicolor*) ; another acquired in Fyzabad with a very tight-fitting waistcoat was found to contain a large toad (*Bufo andersoni*), a lizard of the skink family (*Mabuia dissimilis*), and a young tortoise (*Trionyx*), and, as though dissatisfied with this 3-course luncheon, had endeavoured to include a large lizard, probably of the Genus *Calotes*, since some 5 inches or more of its tail had been devoured. The specimen alluded to above, which bit Mr. Hampton, subsequently disgorged six frogs. A specimen in Almora had eaten six bats. Ferguson comments upon the gluttony of this species, and says its favourite food is a medium-sized frog, of which a fair-sized snake will eat about twenty-two at a meal.

Mr. Hampton says if at all hungry it will not disdain the meal afforded by another snake, including even its own species. This I know to be true, and quite a common event in captivity, which is vouched for by Mr. Millard, Ferguson, and others, but I think it is a rare exhibition of depravity in its natural state ; however, Assistant Surgeon Robertson told me he once cut open a large dhaman and found it contained another dhaman 3 feet 11 inches in length in its stomach. Flower * mentions one eating a snake (*Chrysopelea ornata*). Mr. Green tells me of one which disgorged several snakes of the Genus *Rhinophis* in its death throes, and Lightfoot† has lately presented a specimen to the Bombay Natural History Society preserved in the act of swallowing a *Psammophis condanarus*. The stomach, as will be seen if distended with a meal, lies more in front of the middle point of the body than in some other snakes, notably the Krait and *Hemibungarus*, where it lies wholly behind this point.

Breeding.—(*a*) *The Sexes :* It is the rule with snakes that the female exceeds the male in length. Darwin, on the authority

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* Proc. Zool. Soc. 1899, page 684.

† Bombay Natural History Journal, Vol. XVI., page 530.

of Gunther, makes this statement.* Whilst fully agreeing with this remark, in this species I have no doubt that the converse obtains. An average taken from the largest males and females my notes record shows a disparity decidedly in favour of the male. Again, of specimens over 6 feet 6 inches, twelve are males and only two females. The longest female is 6 feet 7¼ inches. Though usually met with singly, they are sometimes found in pairs at times other than the breeding season. On January 5, 1900, in Rangoon, a male and female were found coiled together beneath a flooring. This date is one later than the normal hatching season. The male was 6 feet 1¼ inches, and the female 5 feet 8½ inches.

I have dissected out the anal glands in a male. They are two in number, and lie above the cloaca, into which they empty, a papilla in the roof indicating the exit orifice. They are elongate sacs, and about 1 inch long in the 8-foot male examined. They act as reservoirs to a peculiar secretion, which is of the consistency of custard, and in the specimen referred to amounted to about half a drachm in each sac. The secretion in this species is yellow, like custard, and has a disagreeable smell. It is supposed that these glands are associated with the sexual functions, but I question this, because I find the secretion abundant in both sexes at all seasons of the year and in the young.

The male genitalia (two) are cylindrical organs when extruded, and are surmounted with a fringe of white, cartilaginous, recurved, spinous processes. Two specially large processes are situated on the ventral aspect of the organ. They serve to effect a very strong conjunction when *in coitu*.

(*c*) *Method of Reproduction:* The species is oviparous in habit.

(*b*) *The Act of Mating:* Major Frere encountered a pair *in coitu* on July 20, and wrote to me as follows concerning the incident: "They were surrounded by thick felled scrub, so I had to kill them, being unable to take them alive. The ventral aspect of their anal shields appeared to be closely approximated. Their bodies were twined together and

* Descent of Man, page 538.

writhing, except for the anterior quarter. Their heads were raised from the ground for 1 foot to 18 inches and appeared to be sparring at each other like two young cockerels. Their movements were active and vigorous." In Fyzabad two were observed courting or mating. The native writer at the Club sent to inform me there were two large snakes playing in the compound. Unfortunately I arrived too late, for the tennis boys had raised a hue and cry and the snakes had fled. They were described as "playing very nicely" for many minutes, their bodies erected and swaying about, and their heads facing one another. I went to the cover they were reported to have entered, flushed one dhaman, which made off, and killed a second, which proved to be a male 6 feet 9 inches long. The next day at the same spot another was killed, which proved to be a female 6 feet 1 inch long, which contained twelve large eggs 1½ inches long, and therefore in an advanced state of development.

On another occasion a pair were found disporting themselves in a pool, and killed. The male was 6 feet 9½ inches long, and the female 6 feet 7½ inches was found to contain eggs in an advanced state of development. It is evident from these two incidents that cohabitation continues for a long time after fruitful union.

When the eggs are laid the female coils up with them. The female was with the eggs I acquired in Fyzabad, and one embryo extracted at the time measured 7¾ inches in length.

(*c*) *Season:* The breeding season varies with the climate. In the plains of India the act of mating was witnessed twice by Coleridge Beadon in June at the base of the Nallamallay Hills. My pair reported in similar circumstances at Fyzabad were seen in July. Major Frere's encounter with two in the act of pairing, near Madras, occurred in July. Nicholson killed two egg-bound females at Bangalore in May. I killed a similar specimen at Banlgaore in May. I had two egg-bound females at Fyzabad in June, ten in July, and one in August, and in Assam three in May, June, and July. One gravid female was killed at Rangoon in July. I acquired one example at Cannanore far advanced in pregnancy in August, and another in November.

Nicholson had a brood hatching out at Bangalore in September. Father Dreckman had a brood which hatched out near Bombay in the same month. My Fyzabad clutch hatched in the same month. A clutch of ten eggs, found in Colombo on October 18, 1917, showed four eggs already evacuated. The remaining six hatched out about three days later (I am informed) in the Museum. Evans and I witnessed the hatching of a brood at Rangoon in December.

My measurements of young furnish a great deal more information, from which I conclude that in the Western Himalayas (Almora), in Chitral beyond the North-west Frontier, and in the Nilgiri and Anamallay Hills the young usually appear in May, June, July, August, and rarely as late as September. In all these localities the winter is severe enough to compel retirement and hibernation. On the other hand, in the plains, where there is no winter, such as in Cannanore, and in Rangoon I got young just hatched in December and January, and none in the summer and autumn months.

(*d*) *Period of Gestation:* Not known.

(*e*) *Period of Incubation:* Not known.

(*f*) *The Eggs:* The number of eggs in a clutch varies from nine to fourteen. They are white, glazed, equally domed at each pole, and have a rather crisp shell, like thick parchment. They are laid in a heap, and, being sticky when voided, adhere wherever they touch one another. The cluster resembles a bunch of huge grapes. They vary a good deal in size. Those I had in Fyzabad varied from 51 to 57 mm. (2 to $2\frac{1}{4}$ inches) in length, and were about 29 mm. (1 1/20 inch) in breadth. Nicholson's clutch were 51 mm. (2 inches) long and 32 mm. ($1\frac{1}{4}$ inch) broad. My Burmese clutch were 41 to 45 mm. long ($1\frac{5}{8}$ to $1\frac{3}{4}$ inch). One of the Colombo eggs is 50 mm. (2 inches) long and 28 mm. ($1\frac{1}{8}$ inch) broad. A single sterile egg taken from the abdomen of a specimen in the Nilgiris measured 60 mm. ($2\frac{3}{8}$ inches) long and 25 mm. (1 inch) broad. It weighed seven-eighths of an ounce.

Growth.—(*a*) *Intraoval Life:* I made some observations on the growth of the hatchling during intraoval life. An egg I opened on August 8 contained an embryo 196 mm. ($7\frac{3}{4}$ inches) long. Another embryo of the same clutch extracted on

August 24 measured 316 mm. (12½ inches) long. Growth about 4 inches in 16 days. The average length on hatching on September 11 and 12 being about 15½ inches, the growth for the last 18 days was about 3 inches. The young snake effects its escape from the egg by means of the fœtal tooth, an osseous structure developed in the præmaxillary bone, which projects under the rostral arch to beyond the snout.

(*b*) *The Hatchling:* The first indication of the hatching of my clutch was the escape of bubbles from cuts in the eggs. Later the heads of the baby snakes appeared, but none seemed specially anxious to leave their cradles. They frequently peeped out and then withdrew into the shell before finally deciding to make their perilous entry into the world, which was not for many hours. Those that hatched from one brood measured from 361 to 428 mm. (14¼ to 16⅞ inches). Those from another varied from 368 to 387 mm. (14½ to 15¼ inches). The six hatched in Colombo I measured. They varied from 435 to 472 mm. (17¾ to 18⅞ inches).

When hatched they are very active little creatures. Mine allowed me to handle them without attempting to bite me, but Father Dreckman was bitten by one of his hatchlings that had some difficulty in getting free from the egg when he tried to help it, and blood was drawn. Mine refused food and milk and soon died.

The genitalia of the males are withdrawn into their sheaths before the young hatch out.

(*c*) *Early Life:* I measured some youngsters after their emergence from the egg and found one grew 1¼ inches in 20 days, though it had refused all food.

The young from my notes appear to double their length in the first year of life, and continue this rate of growth during the second year, when they are about 4 feet long. At the end of the third year of life they are from 5 to 5½ feet long.

(*d*) *Maturity:* It is sexually mature like all other snakes, long before reaching its maximum growth. I have had gravid females 1588 and 1655 mm. in length (5 feet 2½ inches, and 5 feet 5½ inches), which I reckon were just about three years old.

(*e*) *Maximum Length:* I have records of well over 200 specimens, and I have only seen two over 8 feet long. These

were 2,472 and 2,490 mm. (8 feet 1¼ inch, and 8 feet 2 inches). The former had the tail slightly deficient, and might have another inch added. Specimens over 7 feet are decidedly uncommon. Mr. Pratt told me of a specimen he killed in Guzarat measuring 2,643 mm. (8 feet 8 inches). Mr. McDougall some years ago told me of a specimen he killed at Myitkyina, Burma, which he and Lieut. Pritchard measured, and which taped 3,038 mm. (9 feet 11½ inches). Abercromby has recorded some remarkable lengths from Ceylon, viz., 2,897, 2,967, and 3,050 mm. (9 feet 6 inches, 9 feet 8¾ inches, and 10 feet). Mr. Pearless supports this evidence by saying that on three occasions he has measured Ceylon ratsnakes over 10 feet in length. The brood hatched in Colombo already alluded to were considerably longer than Indian hatchlings. Mr. Millard wrote to me of a specimen killed at Mahim, which was 3,583 mm. (11 feet 9 inches).

It seems to me these very extraordinary specimens are examples of gigantism.

Foes.—The Burmese, and many of the wild tribes inhabiting India, eat the dhaman whenever opportunity offers.

I have more than once known a mongoose tackle and overpower one. In Jhelum I saw a mongoose in my compound, evidently hampered by something it was carrying, which when I pursued it dropped. It proved to be a dhaman 3 feet 6 inches long. The snake had been seized by the back of the head, and was being dragged along, in spite of every endeavour to free itself. After killing it I examined the head, and found several teeth had pierced the skull.

Serpent eagles frequently pounce upon and carry ratsnakes aloft.

Ophiophagous snakes, like the hamadryad (*Naia bungarus*) and kraits (*Bungarus cæruleus*), prey upon the dhaman, among other snakes.

I have seen a small spirit specimen in the Madras Museum being engulfed by a large bull frog (*Rana tigrina*).

Legends.—There are various legends connected with this snake. In some parts it is addicted to sucking cows, and apropos of this, it is very remarkable that a feat so manifestly impossible when the snake's mouth is examined should have received credence in many countries in relation to several

species of snakes. It would be impossible for a grasp to be maintained upon the teat without driving home many of the needle-pointed teeth, and inflicting an amount of pain no animal could passively tolerate upon so sensitive a structure. Others attribute to it the curious practice of putting its tail up the cow's nostril and suddenly withdrawing it. What originated this strange belief, and what possible end it might fulfil, is hard even to speculate upon.

Again, it is very generally believed among natives that the ratsnake mates with the cobra, and is, in fact, the male cobra, and it is surprising to me that even some educated English people seriously contemplate such an absurdity, and still further so firmly believe it, as to attempt to vindicate the truth of their assertions. I have more than once engaged in a heated discussion on this subject, but after listening to many assurances, the confession has been invariably elicited that the sexes of the supposed engaging parties had never been investigated.

I think the most convincing argument in disproof of this fable lies in the fact that there are beyond dispute both male and female cobras and both male and female dhamans. One may assume they breed true, since no hybrid, as far as I am aware, has ever been recorded. If the outrageous attachment between Mr. Dhaman and Mrs. Cobra were true, our Museums should be well stocked with evidences of their guilt. It is satisfactory to note, when reflecting upon this alleged flagrant laxity of morals, that one never hears even a whispered imputation breathed by these scandal mongers against the characters of Mr. Cobra and Mrs. Dhaman.

The Rev. Mr. John appears to have originated the idea of an attachment between the cobra and the dhaman, for Russell says Mr. John told him, speaking of the dhaman, that it was often found in company with the cobra. The fact is these snakes are of similar habit and seek out similar quarters, but companionship is merely a matter of accident.

Russell says: "The natives say it is not dangerous, but assert that its bite occasions blindness in persons over forty." Again he says the Rev. Mr. John tells him that the sharpness of its scales sometimes does harm to rice grounds.

Parasites.—(*a*) *Ectozoa:* The dhaman is very frequently infested with ticks, which fasten themselves between the costal scales or the ventral shields. Some that I sent to Professor Nuttall, he tells me, are *Aponomma læve* variety *paradoxum*.

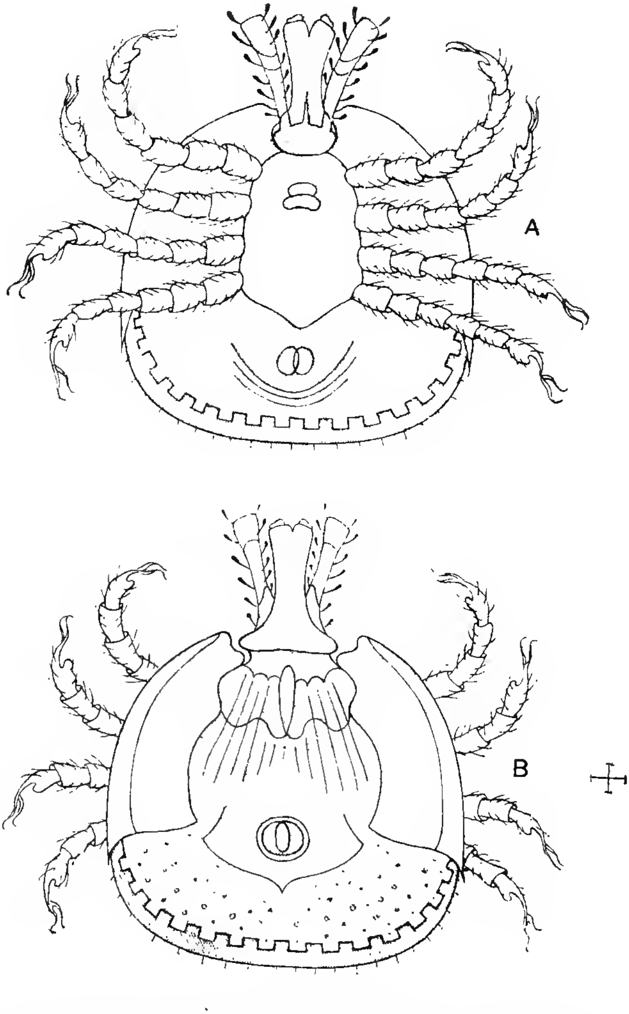

Fig. 38.—Aponomma læve. Tick from Zaocys mucosus (magnified about 18 diameters).—(A) Ventral aspect. (B) Dorsal aspect.

(*b*) *Entozoa* :—The lung of the ratsnake is frequently found tenanted by one or more worm-like parasites, or linguatulids, to which Professor Stephens has given the name *Porocephalus pattoni*. The adult parasite attaches itself to the lung tissue by means of hooks, and there remains and sucks the blood of its host. It is a grayish-white object surrounded by about thirty-six rings or annuli, two of which encircle the head. It grows to about 115 mm. ($4\frac{1}{2}$ inches), and is about 2·5 mm. ($\frac{1}{8}$ of an inch) in diameter. A head, neck, and body are distinguishable. The head is globular, rounded dorsally, and flattened ventrally. The mouth is shaped like an inverted pear, and is surrounded by four strongly-curved hooks, by which the attachment to the lung is effected. A fairly well-defined neck separates the head from the body. The body preserves an even calibre in its entirety, and ends in a blunt extremity. Minute orifices—the cutaneous pores—are seen on the head rings, and those in the anterior and posterior parts of the body. A nearly allied parasite is shown in figure 21.

(*c*) *Hæmatozoa:* The red blood cells of the dhaman are invaded by hosts of parasites called hæmogregarines. Laveran described this under the name *Hæmogregarina zamenis*, and this is probably the same blood organism found by Patton in Indian ratsnakes in 1908, and by Miss Robertson in Ceylon specimens in the same year. (Fig. 39.)

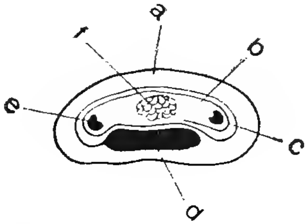

FIG. 39.—Hæmogregarina zamenis (after Miss Robertson).

(a) Red blood cell.
(b) The hæmogregarine.
(c) Capsule of parasite.
(d) Nucleus of cell.
(e) Polar pigment of parasite.
(f) Nucleus of parasite.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures subequal to, or rather greater than the rostro-internasals, longer than the rostro-labials. *Internasals:* The suture between them half to two-thirds that between the præfrontals; three-fifths to two-thirds the internaso-præfrontals. *Præfrontals:* Touch the internasal, postnasal, two loreals, præocular, and supraocular; the suture between them longer than the præfronto-frontal. *Frontal:* The fronto-supraocular sutures fully twice as long as the fronto-parietals. *Supraoculars:* About as long as the frontal, and about as broad along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreals:* Three. *Præocular:* One. *Postoculars:* Two. *Temporals:* Two; the lower as long or nearly as long as the supraocular. *Supralabials:* Eight; 1st and 2nd touching the nasals, 4th and 5th the eye, and the 5th, 6th, and 7th, or 6th and 7th the temporal; the 4th divided. *Sublinguals:* The posterior touch the 5th and 6th infralabials. *Infralabials:* Six, the 5th and 6th subequal; the 6th broader than the posterior sublinguals, and nearly as long; touching two scales behind. (Fig. 40.)

Costals: Vertebrals where the rows are odd, slightly enlarged; the breadth of the scales about three-fourths their length, as broad or broader than the ultimate row. The 3rd to 7th rows above the ventrals slightly oblique, the breadth of these rows about half their length. Last two rows enlarged and rectiform. Ultimate row longer than broad. In 17 rows to behind midbody, reducing to 16 by the absorption of the vertebral row into the uppermost row on the left side; later reducing to 14 or 12 by the absorption of the 3rd row above the ventrals. The median six to eight rows keeled posteriorly. *Ventrals:* 180 to 213. Obtusely angulate laterally. *Anal:* Divided. *Supracaudals:* In even rows, keeled as far as the sixes. *Subcaudals:* 95 to 146; divided.

(*b*) *Anomalies—Loreals:* Not infrequently two (1 + 1), especially in Punjab specimens; sometimes four or even five. *Postoculars:* Rarely three. *Supralabials:* The fourth is sometimes not divided. Occasionally two are confluent to make seven, or there may be a supernumerary one to make

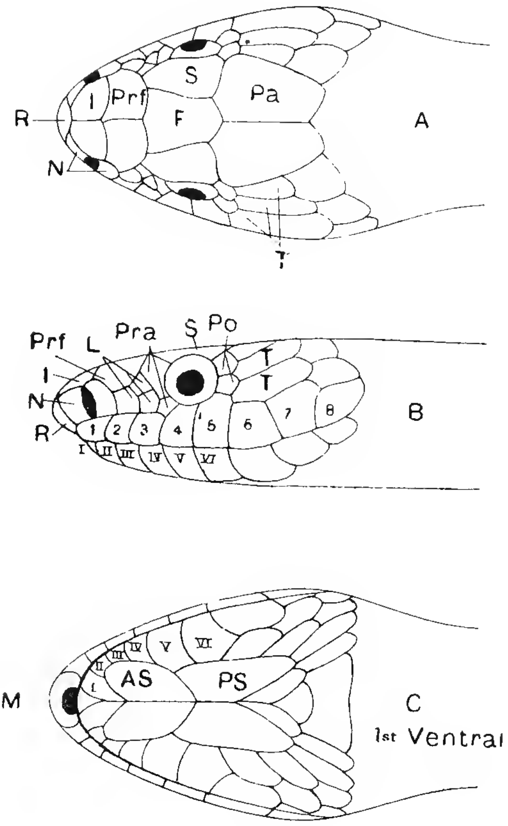

FIG. 40.—Zaocys mucosus (life size).

nine. *Anal:* Rarely entire. *Subcaudals:* A few are occasionally entire.

Dentition.—From six skulls in my collection. *Maxillary:* 20 to 24. *Palatine:* 14 to 18. *Pterygoid:* 21 to 24. *Mandibular:* 17 to 22.

Distribution.—(*a*) *General:* Its range of distribution is very extensive. It is found throughout the whole Indian Peninsula, from Ceylon in the south to the Himalayas in the

north. On the west it extends through Rajputana and Sind to Afghanistan and Transcaspia. In the east it ranges through Burma and Indo-China to Southern China and Formosa. In the Indo-Malay Subregion it occurs in the Peninsula and Java.

(*b*) *Local:* It is an extremely common snake everywhere, and essentially an inhabitant of the plains. It ascends hills, and I have had it frequently from an altitude exceeding 6,000 feet.

Genus ZAMENIS.*

(Greek " za " very, and " menes " strong.)

General Characters.—For Indian species. The species vary from less than 2 to over 8 feet in length. Head more or less oval, moderately depressed. Snout moderately long, narrowing to a more or less obtuse extremity, with an obtusely rounded canthus. Eye moderate to large, with golden iris and round pupil. Nostril variable in size and disposition. Neck fairly evident. Body moderately robust, cylindrical, or compressed. Belly rounded or laterally subangulate. Tail moderate to long.

Identification.—There is no simple way of recognizing the genus as it is now arranged. The following features will assist. One, two, three, or four of the supralabials are divided, beginning with the third or fourth. The posterior sublinguals are completely separated by small scales in nearly all the species. There are six or seven infralabials, the last of which is twice or more than twice as broad as the posterior sublinguals.

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* The genus as defined by Boulenger in his Catalogue (Vol. I., p. 379) includes several species with sufficiently distinctive characters to warrant, in my opinion, recognition under distinct genera. On the maxillary dentition alone, I would divide the genus into at least two groups, equally deserving the rank of genera. Apart from this, a close study of the lepidosis reveals to me differences so great that I would urge a revision of the genus and its separation into many. As now arranged, the genus includes at least thirty-one species, and its division would be a great convenience if this could be established on a scientific basis. I have already shown good reason to exclude one species, viz., *mucosus*, from this genus and place it with *Zaocys*.

Habits.—Diurnal, active, and fierce when attacked.

Food.—Mammals, birds, lizards, and batrachians.

Lepidosis.—*Rostral:* Touches six shields. *Internasals* · A pair. *Præfrontals:* A pair. *Nasals:* Divided. *Loreals:* One. *Præoculars:* One, touching the frontal in some species. *Postoculars:* Two. *Temporals:* Two or three. *Supralabials:* Eight to ten. *Sublinguals:* Two pairs; the posterior separated by small scales in many species.

Costals: Longer than broad, rectiform, smooth, or some rows keeled, with paired apical facets. Vertebrals not enlarged. Ultimate row enlarged. In from 13 to 43 rows at midbody. *Ventrals:* Rounded or laterally subangulate. *Anal:* Usually divided, rarely entire. *Supracaudals:* In even rows. *Subcaudals:* Divided.

Dentition.—*Maxillary:* Syncranterian or diacranterian, coryphodont; 12 to 29 in number. *Palatine:* Isodont, or scaphiodont; 8 to 21. *Pterygoid:* Scaphiodont; 14 to 28. *Mandibular:* Scaphiodont; 14 to 26.

Distribution.—Europe, Asia, North Africa, Senegambia, North and Central America.

There are about thirty species, one of which occurs in Ceylon, viz., *fasciolatus*.

Zamenis fasciolatus (Shaw).

(Latin, Adjectival form of "fascia" a band, and "olus" diminutive, *i.e.*, with little bands.)

Shaw's Zamenis (or Rat Snake).

Synonymy.—*Coluber fasciolatus, C. hebe, C. curvirostris, Coryphodon fasciolatus, Tyria fasciolata.*

History.—Received its first notice from Russell in 1796, who also gave a very good illustration (Plate XXI.) of a juvenile specimen. Christened by Shaw in 1802.

General Characters.—Head moderately depressed, broadest midway between the eye and the neck. Snout moderately long, obtusely rounded terminally, markedly declivous, with broadly rounded canthus. Eye moderate. Nostril in the upper two-thirds of the suture between the nasals. Neck fairly evident. Body elongate, fairly robust, cylindrical, attenuating slightly to the neck, and more markedly posteriorly. Belly very obtusely angulate laterally. Tail about one-fourth to one-fifth the total length.

Identification.—Among Ceylon snakes it is the only species in which the costals are 21 to 23 two heads-lengths behind the head, 23 in midbody, and 17 two heads-lengths before the vent.

Colouration.—The prevailing hue dorsally is some shade of brown, or olive-brown, some specimens being very light and almost yellowish, others a deep rich brown. Young specimens are beautifully ornamented with crossbars formed of black and whitish longitudinal striations. These bars are most conspicuous anteriorly, and gradually disappear before, at, or at some distance behind the middle of the body. They become increasingly obscure as age advances, and some old specimens are nearly uniform in colour. The head is usually uniform olivaceous and without any markings, but a young specimen of mine in Fyzabad was marbled with lighter hues and a nearly complete periorbital white ring. The belly is uniformly whitish or yellowish. In my young specimen it was greenish-yellow.

Habits.—(*a*) *Haunts:* I believe it frequents jungly tracts chiefly, but will stray into populated areas, and, according to Stoliczka, has been known to enter houses in Calcutta.

(*b*) *Disposition:* It appears to be a plucky and vicious snake when molested. The few comments in this direction to be found in the literature on the species are in agreement. Stoliczka says it is rather a fierce snake when molested, and Blanford speaking of a specimen he encountered says, though young, it was one of the fiercest snakes he ever captured. Several specimens I have seen alive betrayed little malice, and allowed me to handle them without attempting to bite.

(*c*) *Striking Posture:* When alarmed it erects the forebody, and flattens the body behind the neck like a cobra. I understand from Mr. Millard, who is very familiar with it, that it is on account of its habit of flattening its body, and a general resemblance in colour and appearance to a small cobra when moving, that the Konkani natives so frequently declare it is a female cobra. Specimens of mine gave a lively exhibition of their cobra-like behaviour. They erected themselves probably as high relatively as a cobra would do, and flattened the forebody very remarkably.

(*d*) *Nocturnal or Diurnal:* It is diurnal in its habits.

(*e*) *Progression:* It is a remarkably lively little snake, so active and alert that its capture is a matter of no little difficulty.

Food.—A specimen sent to me from Patna had swallowed a rat. Stoliczka, however, remarks that it feeds on frogs and worms.

Breeding.—Nothing known.

Growth.—(*a*) *Early Life:* I obtained a small specimen 11¼ inches in length, which appeared to have been but recently born or hatched, in July at Fyzabad. Mr. D'Abreu told me he obtained a similar specimen—length not recorded—in May at Patna.

(*b*) *Maximum Length:* The largest I have examined was 1,283 mm. (4 feet 2½ inches). Mr. D'Abreu has told me of a specimen he acquired at Nagpur that taped 1,347 mm. (4 feet 5 inches).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-internasal and rostro-nasal sutures subequal, or the former rather longer, longer than the rostro-labials. *Internasals:* The suture between them shorter than that between the præfrontals, and shorter than the internaso-præfrontal. *Præfrontals:* The sutures between them subequal to, or rather greater than, the præfronto-frontals; touching the internasal, postnasal, loreal, præocular, and frontal. *Frontal:* The fronto-supraocular sutures fully twice the fronto-parietals. *Supraoculars:* As long as the frontal, and nearly as broad along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreal:* One,

about half to two-thirds the length of the nasals. *Præocular :* One, touching the frontal. *Postoculars :* Two. *Temporals :* Two, the lower not quite as long as the supraocular. *Supralabials :* Eight ; the 1st and 2nd touching the nasals, 4th and 5th the eye, and the 5th, 6th, and 7th the lower temporal ; 4th divided. *Sublinguals :* The posterior pair quite separated by small scales, touching the 5th and 6th infralabials. *Infralabials :* Six ; the 6th largest, broader than the posterior sublinguals, but shorter than those shields, touching three scales behind. (Fig. 41.)

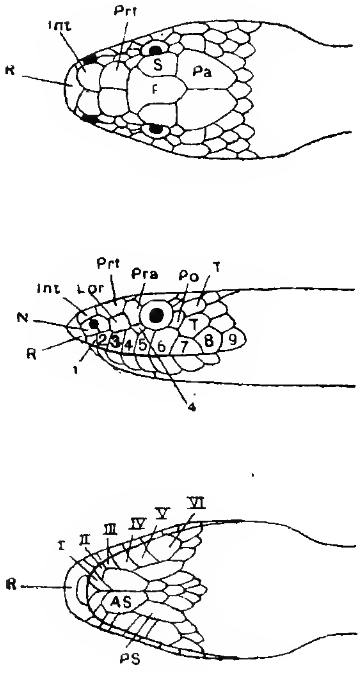

FIG. 41.—Zamenis fasciolatus.
(Life size.)

Costals: Longer than broad, rectiform, smooth, with double apical facets. Vertebrals not enlarged, the breadth of its scales about two-thirds their length, and about half that of the ultimate row. Last five rows progressively broader. Ultimate row broadest, the scales being about as broad as long. In 21 to 23 rows two heads-lengths behind the head, 23 at midbody, 17 two heads-lengths before the vent. The rows usually increase about five heads-lengths from the head by the division of the row next to the vertebral. They decrease behind midbody to 21 by the absorption of the row next to the vertebrals. Later they reduce to 19 by the absorption of the third row from the ventrals. They again reduce to 17 by an absorption of the row next to the vertebral. *Ventrals:* 191 to 232; laterally subangulate. *Anal:* Divided. *Supracaudals:* In even rows. *Subcaudals:* 73 to 92; divided.

(*b*) *Anomalies—Supralabials:* The 4th is rarely undivided. Rarely the 4th, 5th, and 6th touch the eye.

Dentition—From two skulls in my collection. *Maxillary:* Diacranterian. Præcranterian 12 to 13; feebly coryphodont; cranterian 2; not enlarged. *Palatine:* 10 to 11; anododont, feebly scaphiodont; subequal to the maxillary. *Pterygoid:* 15 to 16; anododont, scaphiodont. *Mandibular:* 17 to 18; anododont, scaphiodont.

Distribution.—(*a*) *General:* Peninsular India to the Himalayas and Northern Ceylon.

(*b*) *Local:* In India it has not been recorded north of Gwalior on the western side, and Vizagapatam on the eastern side. In Ceylon Haly mentions one from Jaffna.* Mr. Drummond-Hay tells me he has never obtained a specimen.

Genus COLUBER.

(Latin " coluber " applied to any snake.)

General Characters—For Indian species. The species vary from about 2 to 7 feet in length. Head elongate. Snout moderate or rather long, with a more or less distinct but

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* In my book on the poisonous terrestrial snakes of British India (footnote to page 21) I showed good reason to doubt the authenticity of Cantor's specimen from Province Wellesley.

rounded canthus. Eye moderate or rather large, with round pupil. Nostril open and lateral. Neck fairly distinct. Body moderate to robust, cylindrical, or compressed. Belly rounded, or subangulate laterally. Tail moderate or rather long, from one-third to one-sixth the total length.

Identification.—As now arranged, the species are too varied to allow of any simple method of identification, and a revision of the whole genus is very much needed. The ten Indian species with which I am familiar, and of which I have skulls, warrant this assertion.

Habits.—Terrestrial, diurnal. Active, alert, courageous.

Food.—Mammals, birds, reptiles, and batrachians.

Breeding.—Oviparous.

Poison.—Non-poisonous.

Lepidosis.—*Rostral :* Touches 6 shields. *Internasals :* Two. *Præfrontals :* Two. *Frontal :* Touches six (rarely eight) shields. *Supraoculars :* As long or nearly as long as the frontal, half to three-fourths the breadth of the frontals. *Nasals :* Two ; quite divided. *Loreal .* One (absent in some). *Præoculars :* One. *Postoculars :* Two. *Temporals :* One or two ; well developed. *Supralabials :* Eight to ten ; two or three touching the eye. *Infralabials :* Six or seven. *Sublinguals :* Two pairs ; the posterior equal to, or rather less than the anterior, in contact with one another, or divided by one or more scales.

Costals : Longer than broad, rectiform, smooth, or keeled, with double apical pits. Vertebrals not enlarged ; the breadth of the scales about two-thirds to three-fourths their length, and two-thirds to three-fourths the breadth of the ultimate row. Ultimate row enlarged, the breadth of its scales subequal to their length. The scale rows are very different in the species numbering from 15 to 35 at midbody ; in some the rows are the same number two heads-lengths behind the head, in others two less than in midbody ; in some the rows two heads-lengths before the vent are two less, in others four or six less, than at midbody. *Ventrals :* Rounded, or subangulate laterally. *Anal :* Entire or divided. *Subcaudals :* Divided.

Dentition.—*Maxillary:* 12 to 24; syncranterian, anododont, isodont, or scaphiodont. *Palatine:* 9 to 13; anododont, isodont, or scaphiodont. *Pterygoid:* 12 to 27; anododont, scaphiodont. *Mandibular:* 21 to 31; anododont, scaphiodont.

Distribution.—Europe, Asia, North and Tropical America.

When Boulenger's Catalogue appeared in 1894 forty-five species were recognized. Of these, one occurs in Ceylon, viz., *helena.*

COLUBER HELENA Daudin.

(Named on account of its beauty after Helen, the wife of the Spartan King Menelaus.)

Daudin's Coluber (*or The Trinket Snake*).

Sinhalese: "mudu karawala" (Willey). *Tamil:* "kãttu pámbu" (banded snake).

Synonymy.—*Herpetodryas helena, H. malabaricus, Cynophis bistrigatus, C. malabarica, C. helena, Plagiodon helena.*

History.—Russell first referred to the species in 1796, and gave a good illustration of it in Plate XXXII. of his first volume. Christened by Daudin in 1803.

General Characters.—Head rather narrow, with a somewhat elongate and bluntly-rounded snout. There is little or no indication of a canthus. Nostril fairly large, occupying about three-fourths of the upper part of the suture between the nasal shields. Eye moderately large, rather less than half the length of the snout, and placed laterally. Pupil round, or horizontally elliptical, and the iris adorned with gold. Tongue pinkish at the base, becoming bluish-black, except at the very tips, which are white. I noted in a specimen from the Nilgiris that the mucous membrane of the mouth was blackish. Neck fairly evident. Body robust, compressed somewhat, and smooth. Belly angulated obtusely on either side. Tail short and about one-fifth the total length of the snake.

Identification.—The scale rows 21 or 19 two heads-lengths before the vent, and an entire anal shield will distinguish it from other Ceylon snakes.

Habits.—(*a*) *Haunts :* It is usually to be found in or near jungle, though this may not be very dense. It is very frequently encountered by coolies working on estates. It will quarter itself in and about well-populated areas, being sometimes found in cantonment limits, and it is no unusual circumstance for it to stray into habitations. One was killed in the Municipal Library in Almora two years ago, and another in my sweeper s house. This one would expect from the nature of its food.

(*b*) *Disposition:* All who have remarked upon the species are in agreement as to its vicious temper. Russell speaking of a specimen he had in Vizagapatam says : " It appeared singularly alert in its movements, and snapped at everything presented to it." Colonel Light remarked of one that " it showed great fierceness, and struck repeatedly at the stick when being killed." I have found it a very plucky snake. One fine specimen proved a most truculent snake to capture. It buried its teeth in the butterfly net used to encompass it, and fought till it got itself hopelessly tangled in the net.

(*c*) *Striking posture :* Russell, speaking of one, says : " In preparing to attack, it wreathed its neck, and part of the trunk, into close turns, and at the same time, retracting its head, presented at a distance, something of the appearance of a hooded snake. When it snapped, the body being more raised by the assistance of the tail, the wreaths were rapidly unwreathed, and the head darted obliquely forward with motion so rapid that the animal, without rising from the ground seemed to fly on his prey. In this manner it could unexpectedly seize an object which in appearance lay far beyond its reach. A chicken, intended for experiment, having made its escape, was accidentally pursued into the chamber where the snake had been left at liberty, and was no sooner perceived than the snake flew furiously at him, snapped several times as he passed, and soon seized and secured him by wreathing round the body. In two minutes the bird was

found dead, having been strangled by the snake's tail. A second chicken was attacked in like manner, and had he not been relieved in time would have suffered the same fate. He was bitten in several places."

A specimen I had in Bangalore was wonderfully active. When teased it showed fight by erecting and throwing the fore-part of the body into broad sigmoid curves, which it straightened in the act of striking. It struck out repeatedly and in an upward direction, much like the dhaman (*Zaocys mucosus*). I noticed that prior to striking the neck was markedly compressed, the spine in this region arched, and the throat distinctly pouched, just, in fact, similar to what I have seen in the dhaman under similar circumstances. When erect the body scales anteriorly were separated, revealing the pinkish or lilac colour of the intervening skin, and enhancing the beauty of the reptile.

Food.—Under natural conditions a decided partiality is shown for mammalian fare, but lizards, frogs, and even snakes are acceptable under press of hunger. Mr. Green has frequently seen his captive specimens eat lizards, but he remarks that in hunting lizards it is very inexpert, and repeatedly fails to effect a capture. As soon as the lizard stopped the snake lost interest in it, and appeared attracted by moving objects only. Mr. Millard writing to me some time ago said that a specimen in Bombay refused lizards and frogs, but took a mouse that was offered at once. One voracious individual tried on two occasions to eat snakes with which it was incarcerated. Once the species was *Chrysopelea ornata*, and once *Dendrophis pictus*. Mr. Green remarks that he has several times observed this species capture a small skink. "On one occasion the Coluber had captured a lizard, and was tightly constricting it, the whole body of the snake being twisted into a complicated knot. It commenced work upon the tail, which became detached from the body of the lizard and was promptly swallowed." Miss Montgomery wrote to me of one as follows: "It was coiled round a rat in the butler's house where the roof and wall join. It fell with its prey at his feet in the shape of a ball. The butler killed the two at one blow. The rat had

been bitten in several places." Abercromby says that it has a peculiar habit of encircling and holding its prey in its coils, but that it does not crush its prey.

Breeding.—(*a*) *The Sexes:* Of 44 specimens sexed in the Nilgiri Hills, 26 were males and 18 females. Males have shorter bodies and longer tails than females. The male claspers are cylindrical organs, not bifid at the extremity, and are beset with re-curved, cartilaginous processes.

(*b*) *Method of Reproduction:* It is not known which method of reproduction occurs.

(*c*) *Season:* The fact that no female was gravid out of 107 specimens collected for me in the Nilgiris in June to September, 1917, seems to indicate that the eggs or young had been discharged earlier in the year. Mr. D'Abreu has told me of a specimen which appeared to have been recently born or hatched on March 29 at Nagpur. I had several similar specimens in the Nilgiris in the months of July and August.

(*d*) *Period of Gestation.*—Not known.

Growth.—(*a*) *The Young:* My smallest specimens measured about 330 to 355 mm. (13 to 14 inches) in length, and appeared to have very recently been born or hatched. One in the Colombo Museum is 287 mm. (11¼ inches).

(*b*) *Early Life:* From a good series of 107 obtained in the Nilgiris in 1917, it appears that the young grow about 10 inches in the first, and second years of life.

(*c*) *Maturity:* Not known.

(*d*) *Maximum Length:* Specimens over 1,220 mm. (4 feet) are unusual, and over 1,525 mm. (5 feet) rare. The largest I have seen measured 1,500, 1,575, and 1,590 mm. (4 feet 11 inches, 5 feet 2 inches, and 5 feet 3 inches).

Parasites.—(*a*) *Ectozoa:* I have found some specimens infested with a tick identified by Professor Nuttall as *Aponomma læve* and others with a minute scarlet arachnid, which appears to be the same as those seen on *Oligodon sublineatum* and *Polyodontophis subpunctatus* (fig. 19.)

(*b*) *Entozoa:* I have found many nematode worms in the stomach, which were identified for me as *Kallicephalus willeyi*. Von Linstow records the same worm from the intestine of this snake.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures are greater than the rostro-internasals, and about twice the rostro-labials. *Internasals:* The suture between the internasal pair is about half that between the præfrontal pair and about two-thirds the internaso-præfrontals. *Præfrontals:* The suture between the præfrontal pair is rather greater than the præfronto-frontal; and touches the internasal, postnasal, lorea, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures are nearly twice the fronto-parietals. *Supraoculars:* As long as the frontal, but not quite so broad along a line connecting the centres of the eyes. *Nasals:* Quite divided. *Loreal:* About two-thirds the length of the nasals. *Temporals:* The upper touches the 6th supralabial; the lower is about as long as the supraoculars. *Supralabials:* Nine; the 1st and 2nd touch the nasals, the 5th and 6th, or 5th, 6th, and 7th touch the eye, and the 7th and 8th the lower temporal. *Sublinguals:* Posterior subequal to the anterior, and touching the 5th and 6th infralabials. *Infralabials:* The 6th is nearly as long as the posterior sublinguals, twice or nearly twice as broad, and touches three scales behind. *Costals:* Rectiform; keeled in some of the median rows posteriorly; with paired apical facets. The vertebral row not enlarged; the breadth of its scales about two-thirds their length, and about two-thirds those in the ultimate row. The ultimate row is enlarged, and the breadth of its scales rather less than their length. The rows two heads-lengths behind the head are 21 to 27, and two less than in midbody; in midbody from 23 to 29; two heads-lengths before the vent 21 to 19, or six to eight less than in midbody. The increase of rows anteriorly is due to a division of the 5th, 6th, or 7th rows above the ventrals. The reduction is effected by an absorption of the 3rd, 4th, 5th, 6th, or 7th rows above the ventrals. *Ventrals:* 217 to 265; subangulate laterally. *Anal:* Entire. *Subcaudals:* 74 to 97; divided. *Supracaudals:* In even rows.

(*b*) *Anomalies : Supralabials* may be 10 or 11, and two or three labials may touch the eye from the 6th. *Subcaudals :* Some of the early shields are occasionally entire.

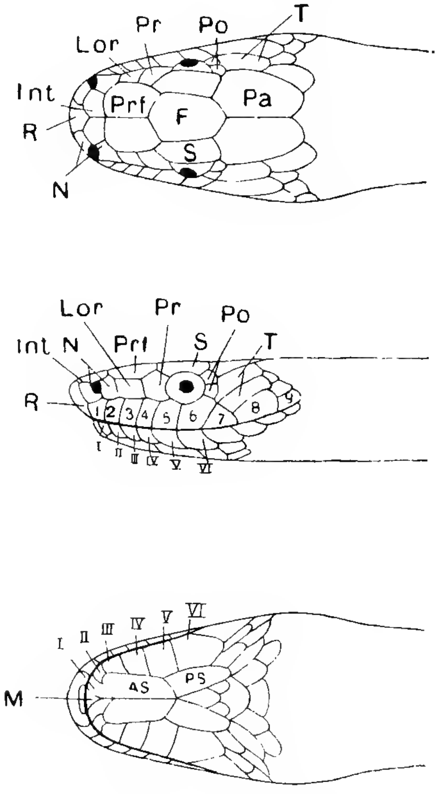

FIG. 42.—Coluber Helena.
(Life size.)

Dentition.—From 5 skulls in my collection. *Maxillary :* 19 to 25. *Palatine :* 10 to 14. *Pterygoid :* 15 to 30. *Mandibular :* 22 to 30.

Distribution.—(*a*) *General :* Ceylon, Peninsular India to the Himalayas. In the north-west it extends to Sind, and in the north-east to Assam.

(*b*) *Local:* It is an extremely common snake in India between about 1,500 and 6,000 feet, but decidedly rare at the level of the plains. In most localities where it has been found at plain level this has been near to hills.

In Ceylon Haly in 1886 said of it: "A very common up-country snake. The collection (*i.e.*, Colombo Museum) possesses no specimen from the low-country." Later in 1891 he records one from Colombo. This might be accounted for by jugglers or others transporting a snake from the hills.

Genus ASPIDURA.

(Greek "aspis" shield, and "oura" tail, in allusion to the subcaudal shields, which are unusual in being entire.)

General Characters.—Small snakes, the largest attaining to about 20 inches. Head moderately elongate, broadest about the posterior edges of the parietals, from which it gradually narrows, to a subacute extremity; moderately depressed. Snout rather long, without canthus. Eye small with round pupil. Nostril small; situated at the lower part of the suture dividing the nasals. Neck not constricted. Body rather short, cylindrical, fairly robust, of even calibre throughout. Belly rounded. Tail short or very short, varying from one-sixth to one-twelfth the total length.

Habits.—Terrestrial. Diurnal. Inoffensive.

Food.—Earthworms and grubs.

Breeding—Oviparous as far as is known.

Poison.—Non-poisonous.

Lepidosis.—*Rostral:* Touches five shields. *Internasal:* One. *Præfrontals:* A pair; touching the internasal, postnasal, 2nd and 3rd supralabials, the præocular when present, the 4th supralabial when a præocular is not present, the eye, and supraocular. *Loreal:* Absent. *Præocular:* Present or absent. *Postoculars:* Two. *Temporal:* One. *Supralabials:* Six; 6th longest; 1st and 2nd touching the nasals, 4th the eye, 5th and 6th the temporal. *Sublinguals:* Two pairs; the anterior twice or more than twice as long as the posterior. Posterior

touching the 4th infralabial. *Infralabials :* Four ; 4th as broad as the posterior sublinguals, and longer than those shields.

Costals : Longer than broad, rectiform, smooth. In males the lateral scales in the anal region are keeled. Vertebrals not enlarged, their breadth about two-thirds their length, about two-thirds the breadth of the ultimate row. The three median rows subequal and smallest, the remaining rows progressively increasing in breadth. Ultimate row with scales as broad as long. In 15 or 17 rows. *Ventrals :* Rounded. *Anal :* Entire. *Subcaudals :* Entire.

Dentition.—From the skulls of four species in my collection. *Maxillary :* Syncranterian, anododont, feebly kumatodont. *Palatine :* Anododont, isodont. *Pterygoid :* Anododont, isodont, except for last two or three, which reduce. *Mandibular :* Anododont, feebly kumatodont.

Distribution.—Peculiar to Ceylon.

Five species have been described, viz., *brachyorrhos, copei, guentheri, trachyprocta,* and *drummondhayi.*

ASPIDURA BRACHYORRHOS (Boie).

(Greek " brachus " short, " orrhos " tail.)

Boie's Aspidura.

Sinhalese : " leymedilla " (Ferguson).

Synonymy.—*Scytale brachyorrhos, Calamaria scytale, Aspidura scytale.*

History.—Described by Boie in 1827.

General Characters.—As detailed under the genus. The snout is obtusely rounded terminally. The tail is about one-ninth the total length.

Identification.—The costals in 17 rows, one præocular and two postoculars touching the parietal, when taken together proclaim the species.

Colouration.—Yellowish or reddish-brown dorsally, with four more or less distinct, darker, longitudinal stripes, and a vertebral series of blackish dots. Some specimens have a few lateral spots anteriorly which alternate with the vertebral series. A dark oblique streak on each side of the neck and sometimes a median nuchal spot. Ventrally uniform yellowish, sometimes sparsely speckled on the body, and with darker mottlings on the tail.

Habits.—(*a*) *Haunts:* Apparently lives beneath the loose soil. The slough found by me had the head embedded in the earth. The three obtained for me by a collector at Kandy were reported dug out of some leaves and débris that had silted up a drain on the hillside.

(*b*) *Disposition:* The three live specimens just referred to allowed me to pick them up and handle them freely, without attempting to bite. They crawled through my fingers restlessly, protruding the tongue frequently.

Food.—The stomachs investigated showed that earthworms had been eaten.

Breeding.—(*a*) *The Sexes:* Females appear to grow longer than males, and have shorter tails. The male clasper is a cylindrical organ beset with fine spinous processes.

(*b*) *Method of Reproduction:* The size and character of eggs extracted by me leaves little doubt that it is an oviparous snake.

(*c*) *Season:* Not known. No dates have accompanied my gravid females.

(*d*) *The Eggs:* Three gravid females that have passed through my hands contained two, four, and five eggs respectively. In one subject these were very large, measuring 28 by 6 mm. ($1\frac{1}{8}$ by $\frac{1}{4}$ of an inch). No embryos could be discovered.

Growth.—(*a*) *The Hatchling:* The length is not known.

(*b*) *Maturity.*—One of my gravid females was 317 mm. ($12\frac{1}{2}$ inches long).

(*c*) *Maximum Length:* The largest record is 390 mm. (15 inches).

Lepidosis.—(*a*) *Typical:* As detailed for the genus except. *Præfrontals:* Touch the 2nd and 3rd supralabials, præocular, and supraocular. *Supraoculars:* Length about two-thirds

the frontal, and half the parietals. *Parietals:* Touch two postoculars. *Præocular:* Present. *Temporal:* Rather longer than the supraocular. (Fig. 43.)

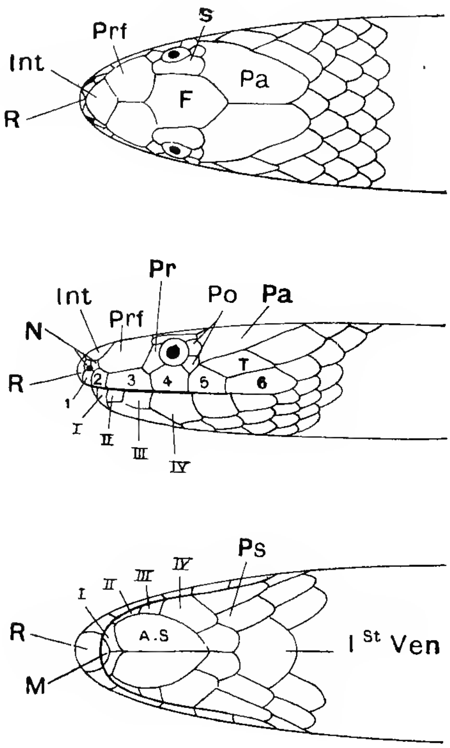

FIG. 43.—Aspidura brachyorrhos.
(× 2.)

Costals: In 17 rows in the whole body length. *Ventrals:* 139 to 155. *Subcaudals:* 27 to 38.

(*b*) *Anomalies:* In one specimen the 13th and 25th subcaudals were divided.

Dentition.—From one skull in my collection. *Maxillary:* 20 to 21. *Palatine:* 16 to 17. *Pterygoid:* 31. *Mandibular.* 21 to 22.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* It is fairly common about Kandy. A man I sent out for snakes brought in three alive one evening, and I found a recently cast slough the same day in a bank by the lake. Green obtained one at Peradeniya, and I have seen others from the same locality. Haly records one from the Horton Plains, and another from Colombo. I examined one collected at Veyangoda by Mr. Carlos Beven. Mr. Drummond-Hay tells me he has never had a specimen, which is remarkable.

ASPIDURA COPEI Gunther.

Cope's Aspidura.

(Named after Mr. E. Cope.)

Synonymy.—*Aspidura brachyorrhos.*

History.—Described by Gunther in 1864.

General Characters.—As detailed for the genus. The snout is obtusely rounded terminally. The tail accounts for about one-sixth the total length.

Identification.—The costals in 17 rows, the absence of a præocular, and the contact of two postoculars with the parietal indicate this species.

Colouration.—Dorsally brownish, powdered with blackish. A series of paired, black, light-edged spots down the back. An oblique black streak on each side of the neck. Labials with blackish posterior borders. Ventrally yellowish, mottled with brown.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—(*a*) *Method of Reproduction:* Not known.

(*b*) *Season:* A gravid female preserved in the Colombo Museum was killed in January, 1906, at Avissawella.

(*c*) *The Eggs:* The specimen just alluded to contained 21 eggs (7 in one ovary and 14 in the other). These measured 20 by 10·3 mm. ($\frac{3}{4}$ by $\frac{1}{2}$ an inch), and were remarkably round. From this it would appear to be the most prolific species of the genus.

Growth.—(*a*) *Maturity:* The one gravid female on record measured 635 mm. (2 feet 1 inch).

(*b*) *Maximum Length:* 635 mm. (2 feet 1 inch).

Lepidosis.—As detailed for the genus, except *Præfrontals :* Touch the 2nd, 3rd, and 4th supralabials, the eye, and the supraocular. *Supraoculars :* Less than half the length of the frontal, and about one-third the parietals. *Parietals :* Touch two postoculars. *Præocular :* Absent. *Temporal :* Twice the length of the supraocular.

Costals : In 17 rows in the whole body length. Obtusely keeled near the anal region. *Ventrals :* 123 to 150. *Subcaudals :* 20 to 35 ; some or all entire.

Dentition.—From one skull in my collection. *Maxillary :* 23 to 24. *Palatine :* 17 to 18 (?). *Pterygoid :* 30 to 34 (?). *Mandibular :* 23.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* Has been reported from Dikoya, Balangoda, and Avissawella. Mr. Drummond-Hay tells me it was not uncommon at Hopewell, Balangoda district, at about 4,000 feet, otherwise he has not met with it. No less than four were dislodged from one field when cleaning out the silt from drains.

Aspidura guentheri Ferguson.

Gunther's Aspidura.

(Named in honour of Mr. Gunther, for many years the Custodian of the Reptile Department in the British Museum.)

Synonymy.—Nil.

History.—Christened in 1876 by the late Mr. W. Ferguson, F.L.S., for many years a notable figure, and a distinguished man of science in Colombo.

General Characters.—As detailed for the genus. The snout is subacute. The body is very short, and the tail accounts for about one-eighth to one-ninth the total length.

Identification.—The costals in 17 rows, the absence of a præocular, and only one postocular touching the parietal will declare the species.

Colouration.—Dorsally nearly uniform darkish brown. When looked into this is seen to consist of a powdering of dark brown on a lighter ground. Three series of small dark spots on the back, one vertebral, and the others on the fifth row above the ventrals. The vertebral series continues on to

the tail, the lateral ceases at the vent and the former alternate with the latter. Belly nearly uniform brown, but seen closely the ventrals are rather darker basally. Head brown with a yellow dark-edged bar on the occiput, proceeding to the gape, and a yellow spot behind the eye.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—Grows to 150 mm. ($5\frac{3}{4}$ inches). Tail 20 mm. ($\frac{3}{4}$ of an inch).

Lepidosis.—*Præfrontal :* Touches the 2nd and 3rd supralabials, præocular, eye, and supraocular. *Supraoculars :* About three-fourths the length of the frontal, and less than half the parietals. *Parietals :* Touch one postocular. *Præocular :* Present. *Temporal :* Longer than the supraocular.

Costals : In 17 rows in the whole body length. *Ventrals :* 101 to 127. *Subcaudals :* 19 to 27.

Dentition.—I have no skull.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* The types are from the coast of the Western Province. Ferguson gave 12 to the British Museum and 7 to the Colombo Museum. Mr. Drummond-Hay tells me he found it a common species on the upper elevations of Hopewell, Balangoda district (about 4,000 feet). It is obviously a fairly common snake but local.

ASPIDURA TRACHYPROCTA Cope.

The Common Roughside.

(Greek " trachus " rough, and " proctos " tail in allusion to the keels on the scales in the anal region of the male.)

Synonymy.—*Aspidura brachyorrhos, A. scytale.*

History.—Described by Cope in 1860.

General Characters.—As detailed for the genus. The snout is rather narrowly obtuse terminally. The tail accounts for about one-twelfth the total length.

Identification.—The costals in 15 rows, and the presence of a præocular will indicate the species.

Colouration.—Very variable. Dark specimens are uniform dark brown or blackish dorsally. Light specimens are dirty yellowish or ruddy dorsally, and these have several series of small black quincunciate spots. The belly is bright canary yellow, orange, rose, carrot-red or berry-red more or less mottled with black. In some the mottling is fine and sparse, in others heavy and predominating over the ground colour. There is usually a more or less conspicuous black stripe along the side of the tail. The brilliant colouring is seen in both sexes, and from the earliest age to maturity.

Habits.—(*a*) *Haunts:* It spends most of its life beneath the soil. The coolies that brought in specimens in such abundance when I was staying with Mr. Drummond-Hay all dug them up. Some of the boys said they had dug up the soil in their vegetable garden, others had removed the débris from the drains, and others again had captured specimens by turning over stones. The sloughs I found had the head always embedded in the soil.

(*b*) *Disposition:* It is an extremely inoffensive little snake, that never attempts to bite however much provoked. Those seized with forceps merely wriggled to try and effect their freedom.

Food.—They live exclusively on earthworms. I have opened the stomachs of many, and found almost all held worms, and the intestines were always loaded with semi-liquid mud from their diet. Many that were put into formalin ejected the contents of the stomach, so as to leave a deposit of earthworms at the bottom of the jar.

Breeding.—(*a*) *The Sexes:* Of ninety brought in on February 29 and March 1, 1920, I found 47 were males, and 43 females. Most adults grow to much the same size irrespective of sex, but the female shows some slight tendency to outgrow the male. The clasper is a cylindrical organ beset with fine spinous processes. The secretion from the anal glands is pale yellowish.

(*b*) *Method of Reproduction.* From the size and character of some of the eggs I have examined there is no doubt that it is oviparous. I have however in the most advanced eggs found extremely minute embryos before oviposition.

(*c*) *Season:* This appears to occupy a considerable period of the year. Among the ninety above referred to I found many gravid. In some ovarian follicles were obviously fertilized, these being enlarged, opaque, and yellow compared with others in the ovaries. Every stage of development was found in various specimens, and in some the eggs appeared to be ripe for discharge. Some females appeared unduly thin, and in poor health suggesting that they had deposited eggs already. Further, the ninety specimens varied so much in length as to suggest that breeding goes on all through the year. Two specimens were between 4 and 5 inches, five between 5 and 6 inches, nine between 6 and 7, four between 7 and 8, five between 8 and 9, nine between 9 and 10, ten between 10 and 11, seventeen between 11 and 12, twelve between 12 and 13, twelve between 13 and 14; and five over 14 inches.

(*d*) *The Eggs:* I have not seen any egg after deposition. The largest I measured after extraction from the parent were about 25 mm. (1 inch) long, and about 16 mm. ($\frac{5}{8}$ of an inch) broad.

No less than fourteen of the ninety specimens just alluded to were egg-bound, and I have examined many others in a similar state. From four to twelve eggs are usually deposited. One female, however, contained twenty eggs in two distinct stages of development. Seven in one ovary and five in the other were large, whilst five in one ovary and three in the other were much smaller. I have no hesitation in pronouncing this a condition resulting from two distinct conceptions, the first I have any knowledge of among snakes.

Growth.—(*a*) *The Hatchling:* The smallest specimens I have examined, which I believe to have been hatchlings, were 106 and 110 mm. ($4\frac{1}{4}$ and $4\frac{3}{8}$ inches) long. Two measuring 106 and 109 mm. ($4\frac{1}{4}$ and $4\frac{5}{16}$ inches) were found in company with a female specimen (presumably the dam) on August 10.

(*b*) *Early Life:* I have not been able to follow the broods, as breeding appears to be going on all the year.

(*c*) *Maturity:* I have found two egg-bound females 280 mm. (11 inches) long and others little longer. The general rule that the longer the mother the larger the brood, is well exemplified from my notes. The largest 412 mm. ($16\frac{1}{4}$ inches)

contained 12 eggs ; one 367 mm. (14½ inches) long contained twenty eggs in two sets ; one 348 mm. (13¾ inches) long contained thirteen eggs ; whilst specimens less than 305 mm. (12 inches long), contained from four to seven eggs.

(*d*) *Maximum Length:* My largest male specimen taped 380 mm. (15 inches), and my largest females 405 and 412 mm. (16 and 16¼ inches).

Foes.—I extracted one from the stomach of another snake, viz., *Ancistrodon hypnale.*

Lepidosis.—(*a*) *Typical :* As detailed for the genus, except—*Præfrontals :* Touch the 2nd and 3rd supralabials, præocular, eye, and supraocular. *Supraocular :* About half the length of the frontal, less than half the length of the parietals. *Parietals :* Touch both postoculars. *Præocular :* Present. *Temporals :* Longer than the supraoculars.

Costals : In 15 rows in the whole body length. The lateral rows about the anal region have claw-like re-curved spines in the males. *Ventrals :* 120 to 151. *Subcaudals :* 11 to 26 (♂ 21 to 26, ♀ 11 to 16).

(*b*) *Anomalies—Præoculars :* I have found these very rarely absent on both sides. *Postoculars :* I have seen these confluent with the parietal on one side. *Supralabials :* I have seen seven occasionally, the 5th touching the eye on both sides in two specimens, and the 4th on one side in one specimen.

Costals : In one female the 2nd and 3rd rows above the ventrals blended shortly behind the head and re-divided and re-united several times so that the scale rows numbered alternately 13 and 15 in the whole body length.

Dentition.—From two skulls in my collection. *Maxillary :* 24 to 25. *Palatine :* 20 to 21. *Pterygoid :* 31? to 35. *Mandibular :* 25 ? to 27.

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* This is the little snake so frequently encountered in Nuwara Eliya. I found five freshly cast sloughs in banks and drains on my first walk half way round the lake in February, and then captured a live specimen. Mr. Drummond-Hay tells me that when he first went to Warwick estate he offered ten cents reward to his coolies for every snake. His first Sunday there produced over three hundred of this species.

Again, when I visited him early in 1920, he told his coolies to bring in snakes, and five youths brought in ninety *trachyprocta* on February 29 and March 1. Its favoured altitude appears to be about 4,000 to 6,000 feet, but I have known it up to about 7,000 feet. It has been reported from Ramboda, Hakgala, Nuwara Eliya, Warwick estate, New Galway district (5,000 to 6,000 feet), Diyatalawa, and Kandy. Mr. Drummond-Hay got it plentifully at Lennock estate in the centre of the Uva patnas (3,000 to 4,200 feet).

ASPIDURA DRUMMONDHAYI Boulenger.

Drummond-Hay's Roughside.

(Named in honour of its discoverer, Mr. H. M. Drummond-Hay.)

Synonymy.—Nil.

History.—Described by Mr. Boulenger in 1904.

General Characters.—As detailed for the genus. Snout subacutely rounded terminally. Tail about one-tenth the total length.

Identification.—The costals in 15 rows in the whole body length, the absence of a præocular, and the divided condition of the subcaudals will establish its identity.

Colouration.—Dark purplish-brown above and below, strongly iridescent, with minute white dots or vermiculations; five rather indistinct narrow blackish stripes, one vertebral and two lateral pass down the back. The latter are on the confines of the 2nd and 3rd and the 4th and 5th rows above the ventrals.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—The maximum length is 220 mm. ($8\frac{1}{2}$ inches), tail 22 mm. ($\frac{7}{8}$ of an inch).

Lepidosis.—(*a*) *Typical:* As detailed for the genus, except—*Præfrontals:* Touch the 2nd, 3rd, and 4th supralabials, the eye, and the supraocular. *Supraocular:* About two-thirds the length of the frontal, and half the parietals. *Parietals:* Touch two postoculars. *Præoculars:* Absent. *Temporals:* Longer than the supraoculars.

Costals: In 15 rows in the whole body length. Those about the anal region are keeled, but not claw-like.

Ventrals: 112 to 135 (♂ 112 to 119, ♀ 135). *Subcaudals:* 18 to 26 (♂ 26, ♀ 18).

(*b*) *Anomalies—Subcaudals:* It is not unusual to find some entire at the base of the tail.

Dentition.—*Maxillary:* 27 to 29? *Palatine:* 25? *Pterygoid:* 29? *Mandibular:* 27?

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* All the specimens obtained by Mr. Drummond-Hay, he tells me, came from Hopewell estate, Balangoda district, at about 4,000 feet.

Genus DENDROPHIS.

(Greek " dendron " tree, " ophis " snake.)

General Characters (for Indian species).—Small snakes, the largest hardly reaching 3 feet. Extremely elegant in colouring, and graceful in conformation. Head elongately pear-shaped, markedly depressed. Snout moderately long, much depressed, broadly rounded terminally, with an obtusely rounded canthus. Lore concave. Eye large, with round pupil. Nostril lateral, round, occupying the full depth of the suture between the nasals. Neck distinct. Body elongate, slender, cylindrical, attenuating towards the neck, and very gradually posteriorly. Belly with pronounced lateral keels. Tail long, about one third, or more than a third, the total length.

Identification.—The enlarged vertebrals, and keeled ventrals will proclaim this genus or *Dendrelaphis*. The maxillary teeth increase in size posteriorly in *Dendrophis*, but decrease in *Dendrelaphis*, or are of equal length. See fig. 45 (*a*) and (*c*).

Habits.—Arboreal. Diurnal. Very active. Courageous.

Food.—Chiefly lizards, and tree-frogs.

Breeding.—Oviparous.

Poison.—Non-poisonous.

Lepidosis.—*Rostral:* Touches six shields. *Internasals:* Two. *Præfrontals:* Two. *Frontal:* Touches six shields. *Nasals:* Divided. *Loreals:* None, one, or two. *Præoculars:* One. *Postoculars:* Two. *Temporals:* Two; anterior very small, two median as long as the last labial, and two posterior as long as the last labial. *Supralabials:* Eight or nine; two or three touching the eye. *Sublinguals:* Two pairs, the posterior subequal to, or longer than, the anterior.

Costals: At midbody. Longer than broad, smooth, with single apical facets. Vertebral and ultimate rows enlarged, rectiform, the intervening rows oblique. Vertebrals enlarged; originating in the neck by a gradual increase in size, or by a confluence of 2 or 3 rows; ending in the anal region. Scale rows 13 or 15. Ultimate row enlarged. *Ventrals:* Strongly keeled laterally. *Anal:* Entire or divided. *Supracaudals:* In even rows. *Subcaudals:* Divided; strongly keeled laterally.

Dentition.—*Maxillary:* Syncranterian, anododont, coryphodont. *Palatine:* Anododont, feebly kumatodont. *Pterygoid:* Anododont, isodont. *Mandibular:* Anododont, kumatodont.

Dendrophis bifrenalis Boulenger.

(Latin "bis" twice, "frenum" literally "a bit," refers here to the loreal shield.)

Boulenger's Bronze-back.

Sinhalese: "haldanda" (Willey) (rice stick).

Synonymy.—*Dendrophis picta.*

History.—Described by Boulenger in 1890. It is nicely figured in Plate IV. of the same author's Catalogue of Snakes, 1894, Vol. II.

General Characters.—As detailed under the genus. The tail is about one-third the total length.

Identification.—The costals numbering 15, except behind where they drop to 11 or 9, the keeled character of the ventrals, and the twin loreals taken together, denote this species among Ceylon snakes.

Colouration.—Uniform bronze dorsally, with narrow, black, oblique streaks anteriorly. A yellow line along the outer row of costals from nape to vent. Head bronze above lips and chin yellow. A dark streak from the lore, and behind the eye to the side of the body. Ventrum greenish-yellow between the keels, bronze above the keels to the light flank lines.

Habits.—Nothing special known.

Food.—I found a small frog in the stomach of one.

Breeding.—My Travancore specimen was egg-bound, but the date unfortunately was not recorded. It contained five large eggs, but I could discover no trace of an embryo within. The species from this is almost certainly oviparous in habit.

Growth.—Boulenger says 1,030 mm. (3 feet 4 inches). My Travancore specimen was 962 mm. (3 feet $1\frac{7}{8}$ inch), tail 368 mm. ($14\frac{1}{2}$ inches).

Lepidosis.—(*a*) *Typical.—Rostral:* The rostro-nasal and rostro-internasal sutures subequal. *Internasals:* The suture between them little shorter than that between the præfrontals, subequal to the internaso-præfrontals. *Præfrontals:* The suture between them longer than the præfronto-frontal, touching the internasal, postnasal, two loreals, præocular, and usually the supraocular. *Frontal:* The fronto-supraocular sutures more than twice the fronto-parietals. *Supraocular:* As long as the frontal, and about as broad along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreals:* Two; one anterior, one posterior; taken together they are longer than the nasals; the anterior touches the internasals usually. *Præocular:* One, nearly touching the frontal. *Postoculars:* Upper larger. *Temporals:* Anterior as small as the postoculars, median and posterior longer, nearly as long as the supraoculars. *Supralabials:* Nine: 1st and 2nd touching the nasals, 5th and 6th the eye. *Sublinguals:* The posterior touch the 5th and 6th infralabials. *Infralabials:* Six; the sixth largest, shorter than the posterior sublinguals, much broader than those shields, touching two scales behind.

Costals: Vertebrals about as broad as long, about as broad as the ultimate row. Ultimate row with scales about as broad as long. In 15 rows two heads-lengths behind the head, 15 at midbody, 11 or 9 two heads-lengths before the vent. The reduction of rows from 15 to 13 is due to the absorption of the fourth row from the ventrals, and from 13 to 11 to the absorption of the fifth row. *Ventrals:* 154 to 176. *Anal:* Divided. *Subcaudals:* 144 to 165.

(*b*) *Anomalies:* The anterior loreal rarely just fails to touch the internasal.

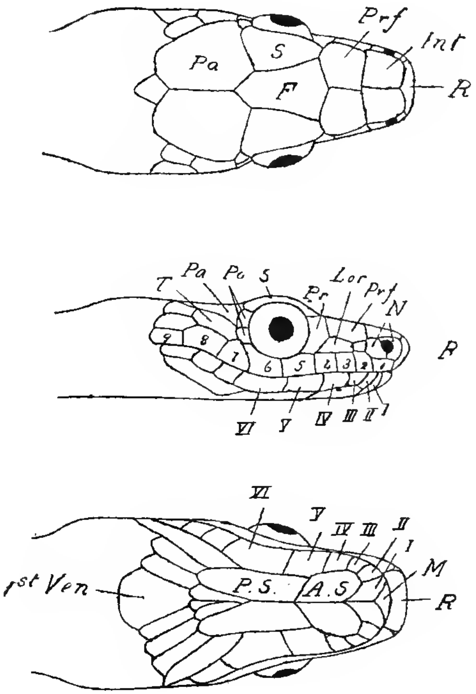

FIG. 44.—Dendrophis bifrenalis.

(× 1½.)

Dentition.—From three skulls in my collection. *Maxillary :* 22 to 25; strongly coryphodont. *Palatine:* 12 to 14. *Pterygoid :* 21 to 27. *Mandibular :* 23 to 27.

Distribution.—(*a*) *General :* South India. Ceylon.

(*b*) *Local.*—The only Indian specimen known was sent to me from Trivandrum, Travancore.

I examined five in the Colombo Museum, one from Punagalla, one from Yatiyantota, and one from Balangoda. In a small local collection made just outside Galle, I found no less than five examples out of fourteen snakes. Mr. Drummond-Hay tells me it is extremely common in the Yatiyantota district, below about 1,000 feet. He never obtained it Up-country.

DENDROPHIS CAUDOLINEOLATUS Gunther.

(Latin " cauda " tail, " lineolatus " diminutive of " lineatus " lined, *i.e.*, with fine lines on the tail.)

Gunther's Bronze-back.

Sinhalese : " haldanda " (Willey) (rice stick).

Synonymy.—? *Dendrophis gregorii, D. caudolineatus.*

History.—Described by Gunther in 1869.

General Characters.—As detailed under the genus. The tail is about one-third the total length.

Identification.—The costals are in 13 rows, reducing posteriorly to 9. Ventrals keeled. *Loreal:* one. These characters taken together will indicate the species.

Colouration.—Uniform bronze dorsally, except for a few black oblique streaks anteriorly. Tail with two black lines on each side. Ventrum greenish-white.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—A gravid female, 868 mm. in length (2 feet $10\frac{1}{4}$ inches long), tail 298 mm. ($11\frac{3}{4}$ inches), is preserved in the Colombo Museum. This was killed by Mr. Drummond-Hay in May, 1903. It contains three very-elongate eggs, measuring 41 by 10 mm. ($1\frac{5}{8}$ by $\frac{3}{8}$ of an inch), with no trace of an embryo.

Growth.—The longest I have seen is the gravid female just alluded to.

Lepidosis.—Only differs from *bifrenalis* in the following:—*Loreal:* One. *Temporals:* One or two anterior. *Supralabials:* Eight or nine; the 4th and 5th, or 5th and 6th, touching the eye. *Costals:* In 13 rows to behind midbody, reducing to 9 two heads-lengths before the vent. *Ventrals:* 149 to 161. *Subcaudals:* 119 to 128.

Dentition.—From one skull in my collection. *Maxillary:* 28 to 29. *Palatine:* 18 to 21. *Pterygoid:* 32 to 34. *Mandibular:* 27 to 30.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* Haly says it appears to inhabit damp forests on low hills. It is evidently a rare snake.

There are three specimens in the British Museum, the exact habitat not specified. Haly records it from Balangoda, Udugama, and Illagolla. I have had three sent to me at different times from Ceylon. Mr. Drummond-Hay took several specimens about Balangoda, between about 2,000 and 3,500 feet, but found it uncommon.

DENDROPHIS EFFRENIS Werner.

(Latin "e" without, and "frenum" the loreal shield.)

Werner's Bronze-back.

History.—Described by Werner in 1909. (Uber neue oder seltene Reptilien de Nat. Mus. Hamburg, 1909, page 221.) May prove to be an aberrant specimen of the last species.

General Characters.—As detailed under the genus. The tail is about two-sevenths the total length.

Identification.—The costals in 13 rows reducing posteriorly to 9, ventrals keeled, and no loreal, if taken together furnish a guide to the identity of the species.

Colouration.—As in the last species.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—The total length is 884 mm. (2 feet 11 inches), of which the tail accounts for 244 mm. (9¾ inches).

Lepidosis.—*Loreal:* None. *Postoculars:* Three. *Sublinguals:* The posterior touch the 4th and 5th infralabials. *Costals:* In 13 rows, at midbody. *Ventrals:* 175. *Subcaudals:* 129.

Distribution.—(*a*) *General:* Ceylon.

(*b*) *Local:* Said to be from Colombo. The only specimen known was sent to Dr. Werner by John Hagenbeck.

Genus DENDRELAPHIS.

(Greek "dendron" tree, and "elaphis" snake.)

General Characters.—The remarks made under *Dendrophis* apply equally to this genus. The species of both genera are extremely alike, and are only separated on account of differences in the posterior maxillary teeth. In *Dendrophis* these are enlarged, in *Dendrelaphis* they are not. (See fig. 45.)

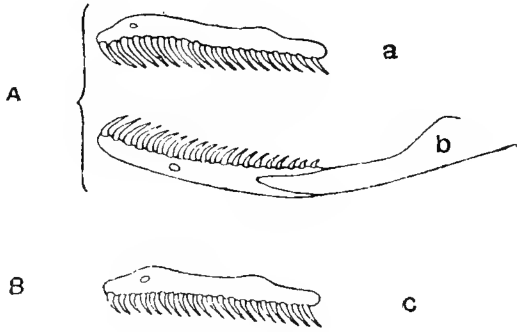

FIG. 45.—A.—Maxilla and mandible of Dendrelaphis tristis.
B.—Maxilla of Dendrophis.

Dentition.—*Maxillary:* Syncranterian, anododont, feebly scaphiodont. *Palatine:* Anododont, feebly kumatodont. *Pterygoid:* Anododont, isodont. *Mandibular:* Anododont, kumatodont.

Six species have been described all from the Oriental Region. Of these, only one, viz., *tristis*, occurs in Ceylon.

DENDRELAPHIS TRISTIS (Daudin).

Variety taprobanensis (Wall).

(Latin "tristis" sad, from its sombre colouration.)

Seba's Bronze-back.

Sinhalese: "haldanda" (rice stick) (Green). *Tamil:* Frequently called "komberi muken" (snouted branch climber), but this name is properly applied to the green whipsnake, *Dryophis mycterizans.*

Synonymy.—* *Coluber tristis, Dipsas schokari, Leptophis mancas, L. pictus, Dendrophis chairecacos, D. maniar, D. boii, D. pictus, D. helena.*

History.—I think there can be no doubt that the earliest figure of this species is shown in Seba's "Thesaurus" (Plate CIX., fig. 1), which appeared in 1734. The figure is taken from a Ceylon specimen referred to by Russell in 1796, and figured by him in his Volume I. (Plate XXXI.). Volume II. Plates XXV. and XXVI. also depict this snake. Christened by Daudin in 1803.

General Characters.—Head depressed. Snout broadly rounded. Neck very evident. Body round, smooth, of nearly even calibre, and very graceful in outline. Belly sharply keeled on each side. Tail also sharply keeled below,

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* There has been much confusion in the past as to the name of this snake. Gunther (Rept. Brit. Ind., 1863) alluded to it as *Dendrophis pictus*. Boulenger (Faun. Brit. Ind., Reptilia, 1890) referred to it under the same title. The same authority, however, in 1894 (Cat. Snakes, Brit. Mus., Vol. II.) adopts the name *Dendrelaphis tristis* for the South Indian and Ceylon form, separating it from *Dendrophis pictus* (Gmelin). Abercromby (Snakes of Ceylon, page 75) uses the old name for it. At least, I presume, it is this species he refers to.

and nearly one-third the total length of the snake. Eye large, with an arc of golden-brown demarcating the pupil, which is round in shape.

Identification.—The costals are in 15 rows and reduce to 11 or 9 in the posterior part of the body. The ventrals and subcaudals are sharply keeled, and there is one loreal. These combined characters will differentiate this from other Ceylon snakes.

Colouration.—Dorsally the snake is a beautiful bronze, each scale more or less bordered basally and apically with black. In many Ceylon specimens there is a conspicuous yellow vertebral stripe involving the vertebral and half the next row of scales. This begins on the nape, and is seen only in the anterior part of the body. There are usually small, black, oblique, streaks anteriorly, and a black line demarcating the dorsal bronze from the creamy ventral colouration. The head is bronze above, and the upper lip is yellow or buff, with the posterior edges of the 1st to 4th or 2nd to 4th labials black. There is a narrow, short, and rather obscure black postocular streak also. The belly is uniform creamy-buff, greyish, or greenish, and the ventral hue is continued on the side of the body to the last costal and half the row above it. The over-lapped portions of the dorsal scales are a bright sky-blue, but this is not evident until the snake, under excite ment, expands itself. When seen in such circumstances, it is a very strikingly beautiful reptile.

I have examined a specimen without any trace of the light vertebral stripe, no black stripes anteriorly, and no postocular streak. The belly was deep plumbeous with some yellowish mottling on each ventral shield subterminally and along the keels, and a light line below the dorsal bronze posteriorly.

Habits.—(*a*) *Haunts :* Seba's bronze-back, like all its allies, lives almost entirely in bushes and trees. I became most familiar with it in Trichinopoly in my early Indian days, when I spent a good deal of my leisure time birds nesting. During my daily excursions I frequently came across it, and have indeed met as many as three or four in a single outing. I frequently discovered it lying on a branch when peering

through low scrub, but if the snake lies still the chances are it would escape detection, looking extremely like a small branch itself. There is no doubt that its colouration is decidedly protective.

An observation of Mr. E. E. Green's in a recent letter exemplifies this. He says: "On September 8, 1903, I placed a branch with green foliage in the snake's cage. Formerly all the different snakes coiled up together amongst the dry foliage of a dead branch, but now they have sorted themselves, the green whipsnakes (*Dryophis mycterizans*) have moved on to the green branch, while the *Tropidonotus* and *Dendrophis* (*Dendrelaphis*, F.W.)—both brown snakes—have remained on the dead branch."

Often gazing up into trees a movement in the foliage, twenty or more feet above, drew my attention to a snake which when shot proved to be this species. I encountered it more than once in holes in trees, sometimes detecting the snake from the ground level with its head peering forth, or when aloft investigating a likely hole for a bird's nest. In the latter circumstances a cane thrust into the hole and briskly stirred about effected its exit. Once the snake vacated its quarters so hastily that it fell to the ground. On one occasion in Colombo, I discovered one in the open and pursued it, but it got into grass and disappeared beneath a log. With some difficulty the log was overturned, but the snake could not be seen, and yet the ground was such that it was impossible for it to have escaped in any direction unseen. After a considerable search a narrow hole was discovered in the log in which the snake proved to have taken refuge. On more than one occasion I have found its slough entwined among the twigs of a crow's nest, which it had evidently visited with the intention of disencumbering itself of a worn-out vestment, as the slough was perfect or nearly so. On one of these occasions I found the snake in a hole in the same tree, and matched it with the slough.

(*b*) *Disposition:* Mr. Ingleby, quoted by Ferguson, says that it is a very lively and plucky snake, and the fact that Mr. Green found one devouring a large bloodsucker lizard (*Calotes versicolor*)—a truculent creature when brought to

bay—sufficiently establishes its reputation for courage. Lately, I saw one recently captured by a juggler in Bangalore strike viciously and repeatedly at the man. On the other hand, some specimens are not vicious, and can be handled without betraying malice. Mr. Green says that his captive specimens were quite gentle, and never attempted to bite when handled.

(c) *Striking Posture:* The specimens I have seen strike did so from the ground. It first raises the forebody, then expands itself, bringing into view the sky-blue ornamentation of the scales. At the same time it compresses the neck, and slightly pouches the throat. Then there is a rapid retraction, and a sudden lunge forward at the object aimed at.

(d) *Nocturnal or Diurnal:* The bronze-backed tree snakes are completely diurnal in habit, their colouration affording them excellent protection.

(e) *Progression:* I know of no more active snake than this Indian bronze-back, and it is most remarkable how expeditiously it can disappear in the face of danger. On the ground it moves very rapidly, with forebody erect, to the nearest cover. If a tree is reached, its speed in ascent is truly amazing. Mr. Green refers to its restless habit and the quickness of its movements. The tenacity with which it can maintain its hold in foliage under most disadvantageous circumstances I have more than once been witness to. I managed to hustle one to the extreme tips of the pendant twigs of a neem tree (*Melia azadirachta*), but though these swayed freely under its weight and movements, the snake remained firmly wreathed round them until I dislodged it with my stick.

Some species of this genus and *Dendrophis* have been reported to "fly." *Dendrophis pictus*, a very nearly allied Indian species, is one of these. It would be more accurate, however, to say these snakes "spring." Under the species *Chrysopelea ornata* I have remarked on this habit. It is interesting to observe in this connection that Pridham* speaks of a snake called by the natives "ahedœlla" in the following

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* Ceylon and its Dependencies, page 750.

terms: "The movements of this snake are rapid, and from its power of springing it is called flying snake." The snake alluded to is no doubt the bronze-backed tree snake or *Chrysopelea ornata*, and not the green whipsnake (*Dryophis mycterizans*), to which the name "ehetulla" properly belongs. Natives are very inexact in their use of names, and frequently apply them wrongly. Dr. J. R. Henderson, writing to me in answer to my queries, said that in Southern India "there is a common belief that *D. picius* (by which he means *D. tristis*) can jump, but I have never seen it do so."

(*f*) *Sloughing:* Some excellent notes on this little studied function were made in the Madras Museum some years ago.* During the official year 1896 one shed its skin on April 2, May 6, June 28, July 27, and October 29. Another on May 13, June 16, July 21, and October 17. In a third instance, a specimen which was acquired on August 12, sloughed on October 24. Now, it is very curious, and apparently something beyond coincidence, that in all three cases there was no desquamation in the months of August and September, though, in the first two cases, there had been a regular ecdysis in several preceding months.

Food.—This tree snake appears to me to subsist under natural conditions, chiefly on lizards, but does not disdain other reptilian fare. Mr. E. E. Green tells me that in captivity "it feeds readily upon small lizards (*Agamidæ, Geckonidæ,* and *Scincidæ*)." He saw one once take and eat a gecko, which it swallowed immediately alive. He also once encountered one eating a full-grown "blood-sucker" lizard † (*Calotes versicolor*), and tells me further that young examples are said to feed on grasshoppers. Ferguson quotes Mr. Ingleby as saying that it is very keen after frogs, and particularly tree frogs. Mr. C. Beadon tells me that he once found one eating a blind snake (*Typhlops* sp.), which returned to its kill after having been disturbed. On occasion it will attack and plunder birds' nests. I once witnessed an encounter between this snake and a pair of black-backed robins (*Thamnobia fulicata*) in the Borella Cemetery in Colombo.

* Administration Report, Madras Govt. Mus., 1896-97.
† Spol. Zeylanica, April, 1906, page 220.

My attention was attracted by the distressed behaviour of the birds, which I approached cautiously, and saw on the ground between a group of gravestones a *tristis* with its head well erected. I was so near that I both saw and heard more than one peck delivered (it appeared to me on the head) by the birds in their agitated flights to an fro. An incautious movement on my part and the snake had slipped away, and no amount of search could reveal its whereabouts. In a croton bush within a yard or two of the encounter I found the robin's nest with eggs. Specimens in the Madras Museum* have fed freely. One ate 79 toads and 1 lizard between August 12 and March 31; another 94 frogs from April 1 to January 21, following; a third 18 frogs between February 13 and March 31; and a fourth 104 frogs, presumably during the year.

Breeding.—(*a*) *Method of Reproduction:* This bronze-back is oviparous in habit. Mr. Green had eggs deposited in his vivarium.

(*b*) *Season:* A gravid specimen killed in September (?) from the Madura District contained eggs. Another specimen killed at Peradeniya at the end of December was found to contain nearly mature eggs. The eggs deposited in Mr. Green's vivarium were voided in January. I had a specimen with eggs from Kil Kotagiri, Nilgiri Hills, in February. A specimen in the Madras Museum deposited six eggs on August 4, 1919. I had a very recently hatched specimen on August 28.

(*c*) *Period of Gestation:* Abercromby says this is from four to five months.

(*d*) *Period of Incubation.*—Abercromby says the eggs hatch in from four to six weeks. (Spol. Zeylan., Volume IX., page 146.)

(*e*) *Number of Clutch:* My scanty records show that from 6 to 7 eggs are laid.

(*f*) *Dimensions of Eggs:* The eggs are remarkably long. Green's deposited eggs were submitted to me, and I found the smallest measured 29 by 10 mm. ($1\frac{1}{8}$ by $\frac{5}{12}$ of an inch), and the largest 35 by 12 mm. ($1\frac{3}{8}$ by $\frac{1}{2}$ an inch). These eggs

* Administration Report, Madras Govt. Mus., 1896–97.

when cut open were found to contain minute embryos curled up in a small oval chamber about the middle of the yolk. (See Fig. 46.)

FIG. 46.—Egg of Dendrelaphis tristis showing chamber and embryo. (Life size.)

Growth.—(*a*) *Length of Young:* The smallest specimen I have seen measured 261 mm. (10½ inches). This was killed on August 28 at Marmagoa, West Coast, India, and appeared to be a hatchling. It is very remarkable that this is the only very young example that has passed through my hands in 25 years.

(*b*) *Early Life:* I have not been able to ascertain the annual growth of this species, not having a long enough series to indicate the broods of successive years.

(*c*) *Maturity:* The smallest gravid specimen I know of measured 521 mm. (3 feet 4½ inches).

(*d*) *Maximum Length:* My largest measurement is 1,240 mm. (4 feet). Abercromby gives a similar length. Boulenger says it attains to 1310 mm. (4 feet 2¾ inches), the tail 420 mm. (16¼ inches).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures longer than the rostro-internasals, more than twice the rostro-labials. *Internasals:* The suture between them subequal to that between the præfrontals, and subequal to the internaso-præfrontals. *Præfrontals:* Touching the internasal, postnasal, loreal, præocular, and supraocular; the suture between them longer than the præfronto-frontal. *Frontal:* The fronto-supraocular sutures more than twice the fronto-parietals. *Supraoculars:* As long as the frontal,

and rather broader along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreal:* One, nearly as long as the nasals. *Præoculars:* One, not nearly touching the frontal. *Temporals:* Anterior small, the median and posterior two-thirds as long as the supraocular. *Supralabials:* Nine; the 1st and 2nd touching the nasals; the 5th and 6th the eye, and the 7th, 8th, and 9th the lower temporal. *Sublinguals:* The posterior pair touch the 5th and 6th infralabials. *Infralabials:* Six, the sixth largest, broader than the posterior sublinguals, but not so long.

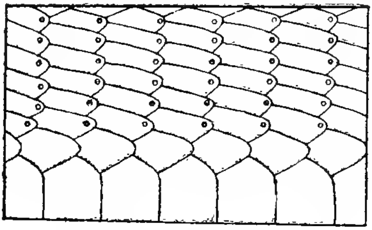

FIG. 47.—Dendrelaphis tristis.

Costals: At midbody. Vertebrals about as broad as long, about as broad as the ultimate row. Oblique rows. The breadth of the scales less than half their length. Ultimate row enlarged, the breadth of its scales subequal to their length. In 15 rows, two heads-lengths behind the head, 15 at midbody, 11 or 9 two heads-lengths before the vent. The rows decrease to 13 by the absorption of the 4th row from the ventrals, to 11 by the absorption of the 5th row, and to 9 by the absorption of the 4th or 5th row. *Ventrals:* 163 to 205. *Subcaudals:* 110 to 150.

(*b*) *Anomalies—Supralabials:* Sometimes eight, the 4th and 5th touching the eye; or ten, the 4th, 5th, and 6tb touching the eye.

Costals : I have seen a specimen in which the scale rows were abnormal, counting 13 for a considerable length anteriorly Just behind the neck the 6th and 7th rows from the ventrals united, the scales then counting 13. The blended rows later redivided and reblended several times, but the count was usually 13. The specimen, a male, was otherwise normal, the ventrals counting 163, and the subcaudals 126

Dentition.—From a Peradeniya specimen in my collection. *Maxillary :* 21. *Palatine :* 13. *Pterygoid :* 27 to 30. *Mandibular:* 24 to 25. This closely agrees with a specimen from Kil Kotagiri in the Nilgiri Hills, in which the *Maxillary* number 21 to 22 ; *Palatine*, 14 ; *Pterygoid*, 28 to 29 ; and *Mandibular*, 24 to 26. In nine other Indian specimens they vary, the *Maxillary* being 17 to 22 ; *Palatine*, 11 to 13 ; *Pterygoid*, 19 to 26 ; and *Mandibular*, 20 to 24.

Distribution.—(*a*) *General :* Peninsular India, Assam, Ceylon. In India it extends north to the Central Provinces and Central India. Further east, it extends to the Himalayas.

(*b*) *Local :* It frequents the plains, but ascends into the hills in India up to at least 5,000 feet. Both Ferguson and Haly report it common in Ceylon. Mr. Drummond-Hay tells me he has never seen it above about 2,000 feet.

Genus OLIGODON.

(Greek " oligos " few, " odous " tooth.)

General Characters (for Indian species).—Small snakes varying between about 1 and 2 feet in length. Head ovate, moderately depressed, broadest a little behind the eyes. Snout short, rapidly narrowing to a subtruncate extremity, without canthus. Eye moderate in size, with round pupil. Nostril small. Neck little, if at all, evident. Body short, stout, cylindrical, of fairly even calibre, or attenuating slightly posteriorly. Belly round or laterally angulate. Tail short, being about one-fifth to one-tenth the total length.

Identification.—The two most distinctive features are that the suture between the internasals is half or less than half the internaso-præfrontals, and the suture between the præfrontals much shorter than the præfronto-frontals. The breadth of the costals is three-fourths or more than three-fourths their length.

Habits.—Terrestrial. Diurnal. Active. Courageous.

Food.—Chiefly lizard's (snake's ?) eggs and frog's spawn. Sometimes lizards and other reptiles.

Breeding.—As far as is known oviparous.

Poison.—Non-poisonous.

Lepidosis (for Indian species).—*Rostral:* Touching six shields (eight in *splendidus*). *Internasals:* A pair usually (four in a transverse series in *splendidus*, absent in *brevicauda*). *Præfrontals:* Two. *Frontal:* Touches six shields. *Nasals:* Entire or divided. *Loreal:* Present or absent. *Præoculars:* One. *Postoculars:* One or two. *Temporals:* One or two. *Supralabials:* Six, seven, or eight; one or two touching the eye. *Sublinguals:* Two pairs; the posterior subequal to or smaller than the anterior.

Costals: At midbody longer than broad, rectiform, smooth, without apical pits or facets. Vertebrals not enlarged. Ultimate row enlarged. In 13 to 21 rows. *Ventrals:* Rounded or angulate laterally. *Anal:* Entire or divided. *Supracaudals:* In even rows. *Subcaudals:* Divided.

Dentition.—*Maxillary:* Syncranterian, anododont, markedly coryphodont; with or without an edentulous space anteriorly; posterior teeth very much compressed, and like the blade of a Gurkha's kukri, hence the name I have applied to these snakes. (See Fig. 49.) *Palatine:* Teeth small and few, isodont; with or without an edentulous space anteriorly and posteriorly; rarely edentulous. *Pterygoid:* Teeth few and small, isodont; with or without an edentulous space anteriorly; rarely edentulous. *Mandibular:* Anododont, feebly kumatodont.

Distribution.—Lower Egypt, South Asia, Malay Archipelago to the Philippines.

The genus comprises about forty species, four of which occur in Ceylon, viz., *arnensis, tæniolatus templetoni*, and *sublineatus*.

OLIGODON ARNENSIS (Shaw).*

(Latin, denoting an inhabitant of Arni in South India, where the type specimen was found.)

The Common Kukri Snake.

Synonymy.—*Coluber arnensis, C. russelius, C. monticolus, Coronella russeli, Simotes russellii, S. albiventer, S. arnensis.*

History.—It was first figured by Seba in 1735. (Thesaurus II., Plate LXII., Fig. 4.) In 1796 Russell figured it twice in his first volume (Plates XXXV. and XXXVIII.).

General Characters.—As detailed under the genus. A neck is fairly evident. The tail is about one-seventh the total length.

Identification.—The costals 17 two heads-lengths behind the head, 17 at midbody, 15 two heads-lengths before vent, and the supralabials seven, with the 3rd and 4th only touching the eye, will distinguish this from other Ceylon snakes.

Colouration.—The ground colour is brown of various hues, inclined sometimes to a ruddy or a purplish tint. It fades to a more or less degree in the flanks. The back is crossed with black bars which are narrowly, but usually distinctly, outlined with whitish or pale yellow. They do not reach

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* This snake has since 1854 been included in the genus *Simotes*. The genus, however, was separated from *Oligodon* by Dumeril and Bibron on the erroneous observation that the species of *Oligodon* had no teeth in the palate. Later, Boulenger, while admitting that some species had palatine teeth, retained the genus on the erroneous observation that species of *Oligodon* had no pterygoid teeth. All the species, included in the two genera that I have been able to obtain skulls of, have pterygoid teeth, except *templetoni*, so that the grounds for separating the two are without foundation. All should, therefore, be included in a single genus, and for this *Oligodon* has priority, dating as it does from 1827.

the ventrals, but break up in the flanks into streaks. They vary somewhat in width, but are, I think, always distinctly narrower than the intervals left between them. Their number seems to vary with the locality. In the United Provinces, Punjab, North-west Frontier, and the Western Himalayas my examples have shown from 41 to 54 on the body, and 9 to 12 on the tail. From Orissa I have had one with 37 bars on the body, and only 6 on the tail. Russell's Arni specimen had only 22 in the whole length, and Gunther mentions one from Ceylon with only 17 on the body. I have seen as many as 62 bars in a specimen from Behar. In the vast majority of specimens these bars are of even width in mid-dorsum and taper costally, but I have seen a specimen in Fyzabad, and another from Bannu, in which they were indented in the median line anteriorly and posteriorly, and converted into twin beads or figures-of-8. This form of mark is common in many of the species of *Oligodon*. In the intervals between the bars the flanks are variegated with short streaks. The belly is usually of a uniform pearly white, but is often black spotted, or, Boulenger says, the ventrals may be bordered at their free edges with brown. The spotted specimens are, I find, not peculiar to any locality, for I have seen a specimen in Almora in which most ventrals had a spot at one or other side, and Boulenger records such from Nepal and South India, where the majority of specimens are unspotted. The head is adorned with three conspicuous black marks which are often, if not usually, bordered narrowly with white or pale yellow. The anterior mark is crescentic, and passes across in front of the eyes to reappear below them. The median and posterior are sagittate, the apex of the former reaching to the frontal and the arms to behind the gape, whilst the apex of the latter passes to the parietals and the arms to the sides of the neck. The posterior sagitta is much the broader one. These three marks are nearly always discrete, unlike the same marks in some other species which are connected by a median shaft. In very old specimens these head marks tend to disintegrate and become obscured. There are usually some dark streaks to be seen in some of the supralabial sutures.

Habits.—(*a*) *Haunts:* Nearly all the specimens I have had came from within Cantonment limits. I have come across many alive on the roads or the wayside, and have even met with it on the open parade ground more than once. More usually it does not stray from within easy touch of efficient cover. It appears to make its home for the most part in masonry, frequently domiciling itself in bungalows and outhouses. I have received many with the report that they were found in the house. Mr. Reid tells me that in Behar, where it is common, it frequents buildings and old walls. I once had one sent to me that had fallen into a well in the compound, having probably fallen from the masonry. One received by me was found at night in the bedding of one of the Gurkhas encamped on granite hill, Almora. This like other kukri snakes is, of course, harmless, but a specimen in Bannu was responsible for the death of a sepoy. I am indebted to Captain Sumner, I.M.S., for the details of the incident. It appears that the sepoy, with others, was on duty at Kurram Garti (8 miles from Bannu) and under canvas. He came off sentry at about 11 P.M., removed his uniform, and laid down on his bed on the ground. He jumped up immediately rubbing his buttock, and declared that something had bitten him there. His companions searched his bedding, and there found a snake which they killed. They examined him, but could see no signs of a bite, and tried to persuade him, though without success, that he had not been bitten. The next morning he did not get up, and his companions could not rouse him. The hospital assistant was sent for and found him comatose. He did what he could for him and sent him in a dhooly to Bannu, but he expired on the way. Captain Sumner here examined the body, and could find no local signs of the bite, and was much perplexed as to the cause of death. The snake was put into a bottle and kept in the hospital, and when I heard of the case I wrote to Lieutenant-Colonel Magrath in Bannu, who sent me the specimen. To my surprise I found the author of the mischief was a common kukri snake, 1 foot $7\frac{1}{2}$ inches long. It seems to me that the man must have died of fright, believing himself bitten.

(*b*) *Disposition:* I do not consider it a malicious snake, though it will sometimes menace, or even inflict a bite when molested or its liberty is jeopardized. I have had many alive, picked up several in their natural haunts, and had more than one in captivity, some showed great timidity, others faced round pluckily and menaced or struck without inflicting an injury, or more rarely actually bit me. Russell had one that he brought face to face with pigeons and chickens, but which he could not induce it to bite.

(*c*) *Striking Posture:* I have seen it inflate its body to a remarkable degree under the influence of excitement. It was noticed that the expansion affected a length of the body considerably in excess of the limits of the lung, for it was observed to reach to the 13th cross-bar. Subsequent dissection showed the lung ended at the 11th cross-bar. In addition to this inflating effort, some specimens may be observed to flatten the posterior part of the head on to the ground by the action of the quadrates, and in so doing they make the neck much more apparent than normal.

(*d*) *Nocturnal or Diurnal:* It is diurnal in habit. I have nearly always encountered it in motion in broad daylight, but some specimens sent to me were killed in bungalows after nightfall.

(*e*) *Progression:* It is an active and vivacious little reptile, easily taking alarm, and hastily attempting concealment. It is often wonderfully adroit in evading swift movements directed towards seizing it by the neck, and has made me realize how cautious one should be in attempting the capture of poisonous snakes in this manner.

It climbs with facility as do most snakes that have their ventrals angulate, this condition approximating to that of the true keeled condition seen in the tree snakes *Dendrophis* and *Chrysopelea*. Two were discovered in Fyzabad, evidently a pair, in the act of scaling a mud wall, another fell off the top of a doorway in Berhampur on to a lady when opening a godown. The situation, some 6 feet from the floor, was a remarkable one for any snake, and an inspection of the place

gave no clue to its probable path of ascent. It is more frequently met with in the rains than at other times during the year.

(*f*) *Sloughing:* I do not know how often desquamation occurs. I have found its sloughs on various occasions, and noted that the black cross-bars are faintly indicated on the discarded vestment.

Food.—I found two eggs of a lizard or snake in the stomach of one specimen. In another I found a similar egg, and an amorphous mass which had formed a rough cast of the stomach. This represented the coagulated yolk of eggs upon which it had feasted. I found a plug of hair in the cloaca of one specimen, indicating that a small mammal had been ingested.

Breeding.—(*a*) *The Sexes:* In Fyzabad out of 15 sexed, 8 proved to be males and 7 females. In Almora of 12 sexed, 9 were males and only 3 females. The female has a relatively longer body and shorter tail, as might be inferred from the difference in the ventrals and subcaudals in the sexes. There appears to be little, if any, difference in the growth of the sexes, for although my two largest records of 2 feet were both females, I have had males 589 and 604 mm. (1 foot $10\frac{3}{4}$ inches, and 1 foot $11\frac{3}{4}$ inches) in length.

There is good reason to think that the pair cohabit long after the act of mating, as I had a male and a female killed in close proximity, the latter in an advanced state of pregnancy.

(*b*) *Method of Reproduction:* It is evidently oviparous in habit. I have had a specimen with large eggs containing no trace of an embryo.

(*c*) *Season:* I had a female with eggs seemingly fit for discharge on August 18, and another on the 22nd of the same month with eggs about half an inch long, which would probably not have been laid till late in September. I had specimens 165 and 168 mm. ($6\frac{1}{2}$ and $6\frac{5}{8}$ inches) long, which I took to be hatchlings in April, and 181 and 193 mm. ($7\frac{1}{4}$ and $7\frac{3}{4}$ inches) long in July.

(*d*) *Period of Gestation:* Not known.

(*e*) *Number of Eggs:* I have had one female with four eggs, and another containing five eggs.

(*f*) *The Eggs:* The eggs just alluded to measured 36 mm. by 10 mm. ($1\frac{4}{10}$ by $\frac{7}{20}$ inches), and were remarkably elongate.

Growth.—(*a*) *Length of Young:* My smallest specimens, which appeared to be hatchlings, were 168 and 170 mm. ($6\frac{1}{2}$ and $6\frac{5}{8}$ inches).

(*b*) *Early Life:* From my records it would appear that the young grow some 4 or 5 inches in the first year of life, and are then 10 to 12 inches long, and 3 or 4 inches in the second year, when they are 15 to 18 inches. At the end of the third year they are over 20 inches.

(*c*) *Maturity:* My smallest gravid female measured 564 mm. (1 foot $9\frac{3}{4}$ inches), and would be, I think, about 3 years old.

(*d*) *Maximum Length:* Specimens exceeding 620 mm. (2 feet) are very unusual. Gunther mentions one 645 mm. long (2 feet 1 inch), and I have had two 620 mm. and 630 mm. (2 feet and 2 feet and $\frac{3}{8}$ of an inch).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasals and rostro-internasal sutures are subequal and much longer than the rostro-labial. *Internasals:* The suture between them is rather less than or subequal to that between the præfrontals; half or less than half the internaso-præfrontals. *Præfrontals:* The suture between them is shorter than the præfronto-frontals; touching the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures are a little longer than the fronto-parietals. *Supraoculars:* Shorter than the frontal, about half the breadth of the frontal along a line connecting the centres of the eyes. *Parietals:* Length subequal to the frontal. *Nasals:* Divided. *Loreal:* About as long as high, shorter than the nasals. *Præocular:* One, not reaching the top of the head. *Postoculars:* Two. *Temporals:* One, nearly as long as the supraocular. *Supralabials:* Seven; the 1st and 2nd touching the nasals; 3rd and 4th the eye; and 5th and 6th the temporal.

Sublinguals : The posterior touching the 4th infralabial. *Infralabials :* Four usually ; the fourth longer and broader than the posterior sublinguals, touching two scales behind. (Fig. 48.)

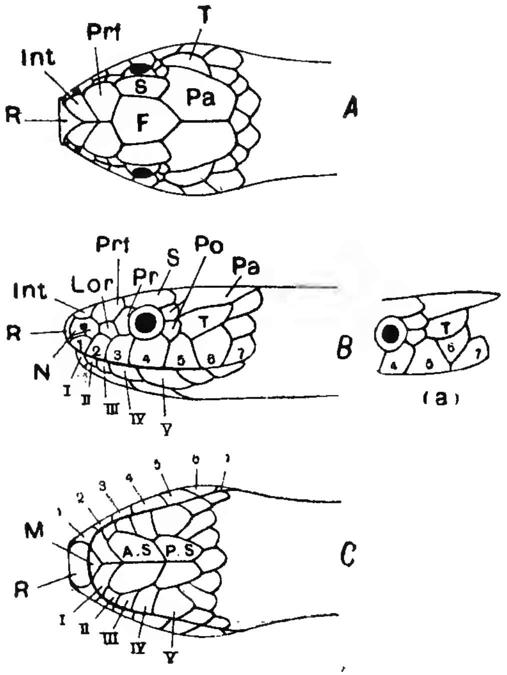

FIG. 48.—Oligodon arnensis.

(× 1½.)

Costals : At midbody, breadth about three-fourths their length, about two-thirds the ultimate row. Last three rows gradually enlarging. Ultimate row about as broad as long. In 17 rows to behind midbody, reducing to 15 by the absorption of the fourth row from the ventrals. *Ventrals :* 167 to 202 ; subangulate laterally. *Anal :* Divided. *Subcaudals :* 41 to 59 ; divided.

(*b*) *Anomalies—Parietals:* There is sometimes a detached fragment forming a pseudo-temporal. *Loreal:* Rarely absent (confluent with the præfrontal). *Supralabials:* One or more are rarely confluent. It is not unusual to see the sixth not reaching the labial margin, but wedged between the fifth and seventh. *Infralabials:* Sometimes five (Fig. 48 C). *Anal:* Rarely entire. *Subcaudals:* A few rarely entire towards the base of the tail.

Dentition.—From three skulls in my collection. *Maxillary:* 7 to 11; an edentulous space anteriorly. *Palatine:* 4 (? 3) to 6; an edentulous space anteriorly and posteriorly. *Pterygoid:* 10 to 17 (?18); no edentulous space anteriorly. *Mandibular:* 13 to 14; no edentulous space anteriorly. (Fig. 49.)

Fig. 49.—(D) Maxilla of oligodon arnensis.
(E) Gurkha's kukri for comparison.

Distribution.—(*a*) *General:* Peninsular India and Ceylon.

(*b*) *Local:* It is a snake that inhabits the plains. In India I have had it fairly plentifully in the Western Himalayas up to 5,000 feet, the highest altitude being 5,500 feet, but I had no specimen from the Nilgiri Hills out of 1,699 specimens collected there in 1917. Haly reports it very common in Ceylon, and remarks he had had no specimens from the hills. Mr. Drummond-Hay has never met with it up-country.

OLIGODON TÆNIOLATUS * (Jerdon).

The Variegated Kukri Snake.

Synonymy.—*Simotes binotatus, Xenodon dubium, Oligodon spilonotus, O. fasciatus, O. subgriseus, Coronella tæniolata.*

History.—Russell appears to have been the first to notice it, and he gives a good figure in his first volume (1796, Plate XIX.). Jerdon christened it in 1853.

General Characters.—As detailed for the genus. There is no indication of a neck. The tail is about one-seventh the total length.

Identification.—The costals in 15 rows in the whole body length, a divided anal, and from 38 to 56 subcaudals will indicate the species.

Colouration.—Like many other snakes *O. tæniolatus* presents considerable differences in its colour and markings. Of the various forms I think four deserve special mention, but the fact that the first three of these are completely connected shows they are all merely variations of a single variety. The fourth form is, I think, probably a distinct species as Gunther originally believed it, however, I prefer for the present to leave it as placed by Boulenger.

†(*a*) Variety *typicus:* This is the *tæniolatus* of Jerdon, and is well figured by Russell.‡ It conforms to variety A

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* It seems to me that the designation of this species should be *O. tæniolatus* (Jerdon). He describes a snake in the Journal of the Asiatic Society of Bengal (Vol. XXII., 1853, page 528) under this name, with 15 rows of scales, ventrals 185, and subcaudals 41, and cites Russell's Plate XIX. of Volume I., so that there can be no doubt to what he alluded saying "it is common at Madras." This name antedates Dumeril and Bibron's *Oligodon subgriseus* bestowed in 1854; but the latter is the one with which all have grown familiar.

† As I am not certain whether all of these forms occur in Ceylon, I have given the varieties in detail, hoping thereby to elucidate the matter. I have seen a specimen of *fasciatus* from Ceylon.

‡ *Loc. cit.*

of Boulenger. The ground colour is buff, pale-brown, cedar-brown, or more rarely a light dun. There is a conspicuous variegation caused by lighter and darker streaks on the anterior-inferior margins of some of the scales. The darker streaks show a marked tendency to congregate at intervals and arrange themselves into cross-bars, which are usually narrowly outlined with buff. These cross-bars narrow or actually break up in the flanks, and are often ill-defined. In many specimens an intermediate series of a less distinct character alternate with them. If looked for, longitudinal stripes similar to those in variety (*b*) are, I think, usually apparent, though often obscure, and the vertebral streak is often interrupted. The belly is unspotted, and the head marks as in variety (*b*). It is much the commonest form and the most widely distributed. Russell's specimen was from Vizagapatam, and Jerdon recorded it from Madras. Blanford obtained it in Ellore and Ajmere. In the Bombay Natural History Society's collection there are specimens from Bombay, Deolali, Karwar, Khandalla, Khandesh, and Goa Ghats. I have lately seen a specimen in the Indian Museum from Dhikala (Garhwal District), and have acquired specimens myself from Delhi, Cannanore, Madras, Trichinopoly, Tutucorin, Vizianagram, Hyderabad (Sind), Dehra Dun, and Shembaganur. In the British Museum it is recorded from the Anamallays.

(*b*) Variety *ceylonicus* (Wall): The ground colour is buff, and four more or less obvious, pale, brownish stripes pass down the body. The two upper and broader pass from the nape where they are confluent to the tail tip. On the body they involve the edge of the vertebral and two and a half adjoining rows. The lower and narrower stripes pass from the neck to the vent, and are placed on the contiguous halves of the 2nd and 3rd rows above the ventrals. The pale vertebral line is continuous and confined to the middle of the vertebral row, except anteriorly, where it expands to the margins of the uppermost costal row. In many of these specimens, an indication of the cross-bars typical of the next form may be seen, if looked for, in the anterior part of the body. The belly is pearly-white and unspotted. The

head is marked with three dark chevrons ; of these the anterior passes across the præfrontals and reappears beneath the eye, the median has its apex on the frontal shield, and its limbs pass obliquely backwards to the gape, frequently blending with the posterior, which is the broadest and situated on the nape, its apex extending forwards to the parietals. These chevrons are usually complete and discrete, but may be more or less incomplete or confluent. A dark streak is always present on the 6th, or between the 6th and 7th supralabials, and there is frequently a streak in the suture between the 1st and 2nd supralabials. This form appears uncommon, and I only know of it from Ceylon. It deserves recognition as an insular variety.

(*c*) Variety *spilonotus* (Gunther) : Agrees with the *dubium* of Jerdon.* This form is very similar to the last, but the cross-bars are modified to form two or four, more or less confluent or completely detached, roundish spots, the median of which are larger and better defined, the lateral often being ill-defined or irregular in form. These marks remind one forcibly of a similar ornamentation seen in *O. venustus*, *O. splendidus* (Gunther), and *O. juglandifer* (Wall). Longitudinal stripes, as in the previous forms, are usually apparent if looked for. The vertebral stripe is often more or less interrupted. The belly is unspotted, and the head marks are as in variety (*b*). Jerdon's specimen was from Canara. I have had it from Matheran, and there are specimens in the Bombay Natural History Society's collection from Bombay and Satara.

(*d*) Variety *fasciatus* (Gunther), Boulenger's variety B : The ground colour is buff or pale yellowish-brown. A median series of largish, well-defined, round spots passes down the back, some of the anterior ones being often divided. Outside, these are irregularly-shaped, ill-defined, smaller dark marks. There are no longitudinal stripes down the body, and any

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* But not the *binotatus* of Dumeril and Bibron, as erroneously supposed by Boulenger (Cat., Vol. II., p. 243). This last is, without doubt, synonymous with *Simotes venustus* having, it is stated, 17 scale rows.

variegation noticeable is confined to the flanks. There are spots near the edge of most of the ventrals on each side. The head marks are as in the foregoing. The specimens recorded by Gunther are from the Deccan and Matheran. Others have been recorded from Bombay, Poona, and Ceylon.

Habits.—(*a*) *Haunts :* It is frequently found in the immediate environment of man. I have had many from gardens in Cantonments, and it is not an unusual visitor in houses, taking up its abode among the pot plants. It evidently frequents marshy places in order to obtain frog's spawn.

(*b*) *Disposition :* The few specimens that have come into my hands alive have all been particularly well behaved, allowing me to handle them freely without attempting to bite. Mr. Gleadow, however, mentions one that he wounded and attempted to carry home over a stick, which repeatedly fell off and on being replaced "savagely attacked" him twice. It is a quietly disposed creature with sufficient spirit, however, to resent interference, and prompt it to make active attempts to escape when encountered.

(*c*) *Nocturnal or Diurnal :* Though often captured at night, it is diurnal in habit, and it is frequently encountered by coolies in the pursuit of their usual avocations.

Food.—Its diet consists of lizard's and snake's eggs and frog's spawn. I have found several with masses of batrachian spawn in the stomach. Where lizard's eggs have furnished the repast, the stomach is sometimes distended with coagulated yolk, that makes a cast of that organ. If this is broken up the empty egg cases will frequently be discovered. Where eggs are on the point of hatching the baby lizards are eaten, either with or without their egg investments. One small example measuring 158 mm. ($6\frac{1}{4}$ inches) had eaten a single lizard's or snake's egg measuring 18 mm. ($\frac{3}{4}$ of an inch) in length.

Breeding.—(*a*) *The Sexes :* Of 28 examples collected in the Nilgiri Hills, 10 proved to be males and 18 females. Females have relatively longer bodies, and consequently more numerous ventral shields.

(*b*) *Method of Reproduction:* It is not known whether it is oviparous or viviparous.

(*c*) *Season:* From my records it would appear that the season for the appearance of the young is a very protracted one. All my specimens ranging between 126 and 188 mm. (6 and 7½ inches) were taken from May to September.

(*d*) *Period of Gestation:* Not known.

(*e*) *Number of Brood:* Not known.

Growth.—(*a*) *Length of Young:* My smallest specimen, apparently a hatchling, was killed in Cannanore in March, and measured 122 mm. ($4\frac{13}{16}$ inches). I have had as many as 14 other examples measuring between 6 and 7½ inches that appeared to be recently born or hatched.

(*b*) *Early Life:* I cannot follow the annual growth from my records.

(*c*) *Maximum Length:* Much my largest specimen, collected in the Nelliampathi Hills, South India, was 585 mm. (23 inches) long, the tail 85 mm. (3⅜ inches). Specimens exceeding 508 mm. (20 inches) are very uncommon.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal and rostro-internasal sutures are subequal and longer than the rostro-labials. *Internasals:* The suture between them subequal to that between the præfrontals or a little shorter, less than half the internaso-præfrontals. *Præfrontals:* The suture between them less than half the præfronto-frontals; touching the internasal, postnasal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures rather longer than the fronto-parietals. *Supraoculars:* About three-fourths the length of the frontal, and half or less than half its breadth along a line connecting the centres of the eyes. *Parietals:* Length subequal to the frontal. *Nasals:* Divided. *Loreal:* About as long as deep; about half the length of the nasals. *Præocular:* Not reaching the top of the head. *Postoculars:* Two. *Temporals:* One; about three-fourths the length of the supraocular. *Supralabials:* Seven; the 1st and 2nd touching the nasals; 3rd and 4th the eye; and

5th and 6th the temporal. *Sublinguals:* Posterior touching the fourth infralabial. *Infralabials:* Four, the fourth longer and broader than the posterior sublinguals. (Fig. 50.)

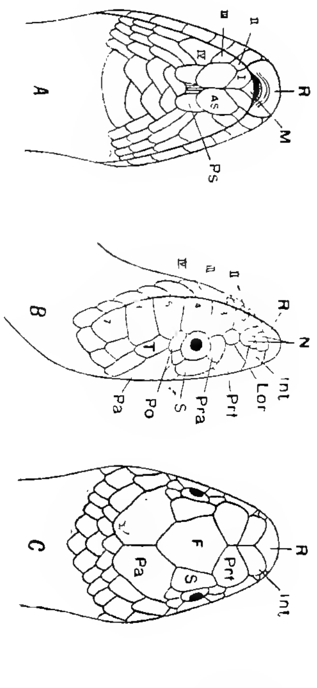

FIG. 50.—Oligodon tæniolatus.

(× $3\frac{1}{3}$.)

Costals—Vertebrals: Breadth about three-fourths their length, and about three-fourths the breadth of the ultimate row. Last two or three rows gradually enlarged. Ultimate row as broad as long; in 15 rows in the whole body length. *Ventrals:* 158 to 218; subangulate laterally. *Anal:* Divided. *Subcaudals:* 34 to 56; divided.

(*b*) *Anomalies—Præfrontals :* Quite separated in one specimen by the anterior angle of the frontal. *Loreal :* Rarely absent, owing to confluence with the præfrontal. *Postoculars :* Rarely three. *Temporals :* Rarely two. *Supralabials :* Sometimes two are confluent to make six, or there may be a supernumerary making eight. *Anal :* Rarely entire. *Subcaudals :* Sometimes a few at the base of the tail are entire.

Dentition.—From five skulls in my collection. *Maxillary :* An edentulous space anteriorly, followed by 6 or 7 teeth. *Palatine :* Edentulous anteriorly and posteriorly ; a single tooth (or none ?) in the middle. *Pterygoid :* Edentulous anteriorly as well as posteriorly ; 6 to 10 teeth in the middle. *Mandibular :* A short edentulous space anteriorly, followed by 12 teeth.

Distribution.—(*a*) *General :* Peninsular India and Ceylon.

(*b*) *Local :* In India it extends to Baluchistan in the north-west, and Purneah in Bengal in the north-east. In Ceylon it has been reported from Colombo and Trincomalee. Most other records give no precise habitat.

It is a denizen of the plains, but ascends high into the hills. I have had it from over 6,000 feet in the Pulneys, and collected no less than 47 from the Nilgiri Hills in 1917.

It does not appear to be common in Ceylon, judging from available records. Mr. Drummond-Hay has never seen it up-country.

OLIGODON TEMPLETONI Gunther.

(Named in honour of Dr. R. Templeton, who obtained the first known Ceylon specimen.)

Templeton's Kukri Snake.

Synonymy.—Nil.

History.—Described by Gunther in 1862. It was referred to again, and figured by the same authority in 1864 in his Reptiles of British India. (Plate XIX.. Fig. C.)

General Characters.—As detailed for the genus. Body of moderate girth and equal calibre throughout. Neck not evident. Tail about one-sixth to one-seventh the total length.

Identification.—The costals in 15 rows in the whole body length, a divided anal shield, and subcaudals less than 36 will indicate this or the next species. *templetoni* is known from *sublineatus* by the belly being boldly dappled with black and white.

Colouration.—Dorsally brown, with a more or less distinct yellowish vertebral stripe, more distinct posteriorly and especially on the tail. About 18 narrow dark cross-bars. An oblique dark stripe below the eye, and indistinct markings on the top of the head. Ventrum with squarish black and white evenly distributed spots. Mr. Green tells me that in life the ventral white spots seen in spirit specimens are yellow or pinkish.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—(*a*) *The Young:* One in the Colombo Museum measures 126 mm. (5 inches), but as the navel is completely obliterated it is almost certain that the young at birth are even smaller than this.

(*b*) *Maximum Length:* A female in the Colombo Museum measures 290 mm. ($11\frac{1}{2}$ inches). This is the largest I am aware of.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal and rostro-internasal sutures are subequal and rather longer than the rostro-labials. *Internasals:* The suture between them shorter than that between the præfrontal pair; less than half the internaso-præfrontals. *Præfrontals:* The suture between them about three-fifths the præfronto-frontals; touching the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures

rather longer than the fronto-parietals. *Supraoculars:* Rather shorter than the frontal, and about one-third the breadth of the frontal along a line connecting the centres of the eyes. *Parietals:* Subequal in length to the frontal. *Nasals:* Divided. *Loreal:* As long as deep, or a little longer; about half the length of the nasals. *Præocular:* Not reaching the top of the head. *Postoculars:* Two; both touching the parietals. *Temporal:* One. *Supralabials:* Seven; the 1st and 2nd touching the nasals; 3rd and 4th the eye; and 5th and 6th the temporal; 6th often cuneate and not reaching the border of the lip. *Sublinguals:* The posterior touch the fourth infralabial. *Infralabial:* Four; the fourth longer and broader than the posterior sublinguals, touching two scales behind.

Costals: Vertebral row: Breadth of scales about three-fourths their length, and about three-fourths the ultimate row. Last two or three rows gradually enlarged. Ultimate row: Breadth of its scales subequal to their length. In 15 rows, in the whole body length. *Ventrals:* 127 to 152 (♂ 127 to 138, ♀ 143 to 152); not angulate. *Anal:* Divided. *Subcaudals:* 20 to 34 (♂ 28 to 34, ♀ 20 to 24); divided.

(*b*) *Anomalies—Loreal:* Sometimes touches the eye below the præocular. *Postoculars:* Sometimes only the upper touches the parietal. *Sublinguals:* The posterior rarely touch the 3rd as well as the 4th infralabials.

Dentition.—From one skull in my collection. *Maxillary:* 7; an edentulous space anteriorly that would take two teeth. *Palatine:* Edentulous. *Pterygoid:* Edentulous. *Mandibular:* 7; a short edentulous space anteriorly.

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* It has been reported from Ratnapura, Hewissa, Balangoda, Peradeniya, and Udugama at sea level. I examined eight in the Colombo Museum. Mr. Drummond-Hay obtained two or three at Hopewell, Balangoda (3,000 to 4,200 feet), but says it is decidedly rare there.

OLIGODON SUBLINEATUS Dumeril and Bibron.

(Latin " sub " beneath, and " lineatus " lined, referring to the dark lines on the belly.)

Dumeril's Kukri Snake.

Synonymy.—Nil.

History.—It was described by Dumeril and Bibron in 1854.

General Characters.—As detailed under the genus. Neck not constricted. Body slender, and of even calibre throughout. Tail about one-ninth the total length.

Identification.—As indicated under the last species. It bears a striking superficial resemblance to the poisonous snake *Callophis trimaculatus.*

Colouration.—Dorsally brown, with a series of paired dark brown light-edged smallish spots, which occasionally alternate. A chevron-shaped dark band on the snout, reappearing beneath the eye. A similar transverse band on the posterior half of the frontal and extending on to the parietals. A band on the nape, sometimes interrupted, sometimes extending forwards to meet the band previously noted. Ventrally yellowish, with three series of dark spots, the lateral often confluent to form a stripe, the median ending at the vent.

Habits.—Nothing known. Mr. Green informed me that Dr. Escherich found one in a nest of termites of the species *Termes redemanni.*

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—The maximum length appears to that reported by Boulenger as 315 mm. ($12\frac{3}{8}$ inches), tail 35 mm. ($1\frac{3}{8}$ inches).

Parasites.—(*a*) *Ectozoa :* I have found many mites attached to this snake at times. Some submitted by me to Professor Nuttall, I am informed, are larval forms of some undeterminable species, probably a *Gekobia.* It is shown in Fig. 19.

Lepidosis.—(*a*) *Typical—Rostral :* The rostro-nasal and rostro-internasal sutures subequal and longer than the rostro-labials. *Internasals :* The suture between them

subequal to that between the præfrontal pair, less than half the internaso-præfrontals. *Præfrontals:* The suture between them half the præfronto-frontals; touching the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures subequal to or rather longer than the fronto-parietals. *Supraoculars:* About three-fourths the length of the frontal, and less than half of that shield along a line connecting the centres of the eyes. *Parietals:* As long as the frontal. *Nasals:* Divided. *Loreal.* Rather longer than deep; half the length of the nasals. *Præocular:* Not reaching the top of the head. *Postoculars:* Two; one or both touching the parietals. *Temporals:* One; about two-thirds the length of the supraoculars. *Supralabials:* Seven; the 1st and 2nd touching the nasals, 3rd and 4th the eye, and the 5th and 6th the temporal. *Sublinguals:* The posterior touching the 4th, or 3rd and 4th, infralabials. *Infralabials:* Four; the 4th as long as the posterior sublinguals, and rather broader than those shields; touching two scales behind.

Costals. Vertebral row: Breadth about three-fourths their length; about two-thirds the ultimate row; the last four rows gradually enlarging. Ultimate row: Breadth of scales subequal to their length. In 15 rows in the whole body length, or reducing to 13 shortly before the vent. The reduction of rows is due to the absorption of the third row from the ventrals. *Ventrals:* 130 to 160 (♂ 130 to 144, ♀ 149 to 160); obtusely angulate laterally. *Anal:* Divided. *Subcaudals:* 23 to 36 (♂ 32 to 36, ♀ 23 to 30); divided.

(*b*) *Anomalies—Supralabials:* I have found the second and third completely confluent.

Dentition.—From two skulls in my collection. *Maxillary:* 7 to 8; an edentulous space anteriorly that would take about two teeth. *Palatine:* None. *Pterygoid:* 4 to 6; a long edentulous space anteriorly. *Mandibular:* 9 to 10; an edentulous space anteriorly that would take two or three teeth.

Distribution.—(*a*) *General:* Ceylon. The Nicobar Islands (?)*

(*b*) *Local:* A low-country snake, which, Haly says, will ascend to about 4,000 feet. Ferguson reported it common

* I discredit this locality.

about Colombo. Mr. Drummond-Hay regards it as one of the commonest Ceylon snakes. He was specially acquainted with it in the Ratnapura and Yatiyantota Districts below about 1,000 feet, but has had it at Hopewell over 3,000 feet. Practically all the small collections I examined contained specimens.

Genus ABLABES.

(Greek " a " without, " blabe " harm.)

General Characters (for Indian species).—Small snakes between about 1 and 2 feet in length. Head small, moderately depressed. Snout moderate in length, strongly declivous, obtusely rounded terminally, without canthus. Eye moderate in size, with round pupil. Nostril small, round, pierced in the middle of a single shield. Neck but little evident. Body rather slender, cylindrical, of even calibre throughout. Belly rounded. Tail about one-third to one-fifth the total length.

Identification.—There is nothing distinctive in the lepidosis by which one can easily recognize the genus. In fact a study of my skulls leads me to think that the genus as now constituted calls for revision and regrouping.*

Habits.—Terrestrial. Diurnal.

Food.—I am not aware of the diet.

Breeding.—Nothing known.

Poison.—Non-poisonous.

Lepidosis.—*Rostral*. Touches six shields. *Internasals :* A pair. *Præfrontals :* A pair. *Frontal :* Touches six shields. *Nasal :* Entire. *Loreal :* Present or absent. *Præocular :* One. *Postoculars :* Two. *Temporals :* One. *Supralabials :* Six, seven, or eight ; two touching the eye. *Sublinguals :* Two pairs, subequal, or the posterior longer or shorter than the anterior. *Infralabials :* Five ; the 5th largest, touching two or three scales behind.

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* In *A. calamaria* the posterior pterygoid teeth are remarkably enlarged. I have not seen a similar condition in any other snake, and on this feature alone I would separate this species from the others of the genus with which it is now associated. I see skull differences also in *A. rappi*, *major*, and *frenatus* that seem to justify generic rank being accorded to them.

Costals : Longer than broad, rectiform, smooth, with no apical facets or pits. Vertebrals not enlarged. Ultimate row enlarged. In 13 to 17 rows at midbody. *Ventrals :* Rounded. *Anal :* Entire or divided. *Supracaudals :* In even rows. *Subcaudals :* Divided.

Dentition.—*Maxillary,* Syncranterian, anododont, isodont. *Palatine :* Anododont, isodont. *Pterygoid :* Anododont, isodont. *Mandibular :* Anododont, feebly kumatodont.

Distribution.—South Asia. Japan.

Ablabes calamaria Gunther.

(Latin " calamus " a pen.)

*Gunther's Reed Snake.**

Synonymy—*Cyclophis calamaria, C. nasalis, Homalosoma baliolum.*

History.—Described by Gunther in 1858.

General Characters.—A little snake hardly reaching 18 inches in its adult state. Head little depressed. Snout moderate in length, obtusely rounded terminally, without canthus. Eye moderate in size. Nostril pierced in a single elongate nasal shield. Neck hardly evident. Body slender, cylindrical, of even calibre throughout. Belly rounded. Tail about one quarter the total length, ending in an extremely fine point. It was doubtless this observation that caused Gunther to attach the name *calamaria* to it.

Identification.—The costals in 15 rows in the whole body length, taken with the very long entire nasal shield (as long or longer than the diameter of the eye) will establish its identity.

Colouration.—Dorsally olive-green, usually with a fine blackish line along the confines of the 5th and 6th rows above the ventrals. This line breaks up into spots anteriorly and continues well on to the tail. A less distinct but similar line runs along the confines of the 3rd and 4th rows. An ill-defined but distinct dark patch is seen on the parietal region in some

* In my article on the Nilgiri snakes (Bombay Nat. Hist. Jour., Vol. XXVI., p. 569) I called it the " Western reed snake," overlooking the fact that it occurs in the Western Himalayas.

young specimens, but this and the dorsal lines become obscure or even effaced with age.

Some young specimens exhibit white linear stripes on the confines of the 2nd and 3rd, 4th and 5th, 6th and 7th, 7th and 8th rows and the 8th row and vertebrals, all of which begin in the neck and end at the vent. The belly is uniform pale yellow.

Habits.—Nothing known.

Food.—No observations have been recorded as to its diet.

Breeding.—(*a*) *Method of Reproduction:* It is not known whether it is oviparous or viviparous.

(*b*) *Season:* A specimen 125 mm. (5 inches) long, which seemed to have just embarked upon life, was captured in the Nilgiris early in August.

Growth.—(*a*) *Length of Young:* Gunther mentions a specimen 102 mm. (4 inches long), and I have had one seemingly just born or hatched that was 125 mm. (5 inches).

(*b*) *Early Life:* It appears to double its length in the first year of life, being then about 215 to 256 mm. ($8\frac{5}{8}$ to $10\frac{1}{4}$ inches) long.

(*c*) *Maximum Length:* Gunther gives 407 mm. (16 inches), the tail 102 mm. (4 inches). I have seen no larger example.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures are longer than the rostro-internasals and the rostro-labials. *Internasals:* The suture between them about three-fourths that between the præfrontals, half or less than half the internaso-præfrontals. *Præfrontals:* The suture between them about three-fourths the præfronto-frontals; touching the internasal, nasal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures rather longer than the fronto-parietals. *Supraoculars:* Length about four-fifths the frontal, breadth about half the frontal along a line connecting the centres of the eyes. *Nasal:* Entire, elongate, apparently confluent with the loreal, touching the præocular. *Loreal:* Absent. *Præocular.* One; not reaching the top of the head. *Postoculars:* Two. *Temporal:* One. *Supralabials:* Seven; the 1st and 2nd touching the nasals, the 3rd and 4th the eye, and the 5th and 6th the temporal. *Sublinguals:* The posterior rather shorter than the anterior; touching the 4th and

5th infralabials. *Infralabials :* Five ; the 5th shorter than the posterior sublinguals, and about as broad as those shields ; usually touching three scales behind. (Fig. 51.)

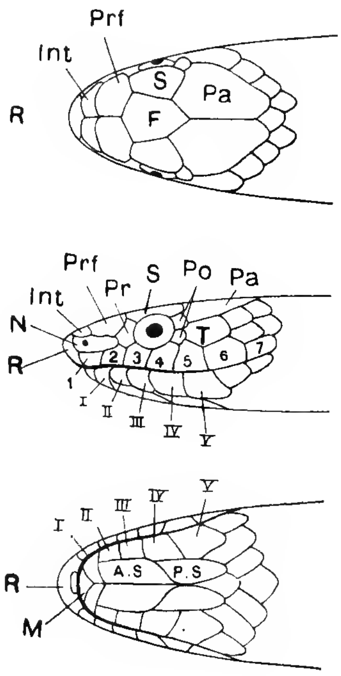

Fig. 51.—Ablabes calamaria.
(× 2.)

Costals : Vertebrals nearly as broad as long, about three-fourths the breadth of the ultimate. Ultimate row with scales as broad as long. In 15 rows in the whole body length. *Ventrals :* 126 to 163. (127 to 134 in Ceylon specimens). *Anal :* Divided. *Subcaudals :* 53 to 76 (67 to 76 in Ceylon specimens).

(*b*) *Anomalies—Præoculars :* Rarely two. *Supralabials :* Sometimes eight. *Infralabials :* Four only in some specimens, owing to a confluence of the normal fourth and fifth.

Dentition.—From one skull in my collection. *Maxlliary :* 21 (?) to 24 (?). *Palatine :* 15 to 16. *Pterygoid :* 15 to 16; larger than those in any of the other jaws. *Mandibular :* 18 to 21.

Distribution.—(*a*) *General:* Hills of Peninsular India and Ceylon.

(*b*) *Local:* In India I have seen examples from Mahableshwar, Wynaad, Nilgiris, and Bangalore. In the Himalayas from Almora, Gonda, Philibhit, and Baksa Dooars. It is not uncommon about Bangalore.

In Ceylon it appears to be uncommon. I saw no specimen in any collection. No precise localities are on record.

Sub-family 3 **Rachiodontinæ.**

(Greek " rachis " the spine, " odous " tooth.)

Identification.—There is nothing distinctive whereby the the sub-family can be recognized on external characters. It is separated on osteological characters from the other sub-families, the most distinctive difference being that the spine in its second eighth has several of the hypopophyses remarkably developed, so that they penetrate the gullet, and act as œsophageal teeth.

Food.—Lives on birds' eggs, which are sawn in halves by the œsophageal teeth.

Distribution.—Peculiar to Africa.

Series B. OPISTHOGLYPHA.

Sub-family 4 **Homalopsinæ.**

(Takes its name from the type genus *Homalopsis.*)

General Characters.—Head moderate to large; snout moderate to long, without canthus. Nostrils valvular and superior. Eye small, with vertically elliptic pupil. Neck fairly evident. Body cylindrical, moderate in calibre, or stout. Belly rounded. Tail short, somewhat compressed basally.

Identification.—Known by the cylindrical tail and the valvular superior nostrils. The ventrals too are rather narrow, so that when homalopsids are laid on their backs two or more costal rows can be seen on each side of them.

Habits.—Aquatic. They inhabit lakes, rivers, and coasts. As far as is known all are viviparous.

Food.—Exclusively fish.

Poison.—Very feebly poisonous, innocuous to man.

Lepidosis.—Head covered above with large shields of the Colubrine type.

Costals : Longer than broad ; rectiform throughout ; keeled or smooth. *Ventrals :* Narrow, about three times the breadth of the last costal row ; rounded or obtusely keeled laterally. *Anal :* Divided. *Subcaudals :* Divided.

Distribution.—South-east Asia, Papuasia, North Queensland.

Ten genera are known, two of which are represented in Ceylon, viz., *Cerberus* and *Gerardia.*

Genus CERBERUS.

(Greek " kerberus " the famous three-headed dog that guarded the entrance to Hades in Grecian mythology. The name appears to have been suggested by the forbidding aspect of the snake, which has the jaw very under hung.)

General Characters.—Smallish snakes, 2 to 4 feet in length. Head pear-shaped as seen from above, expanding considerably towards the occiput. Snout narrow, in profile showing an unusually prominent lower jaw, little shorter than the upper. This feature to a large extent gives the snake its forbidding expression. Nostrils directed almost as much upwards as laterally, narrow slits convex forwards. They approach the condition seen in the seasnakes. Eye rather small, directed as much upwards as laterally, with the eyebrow remarkably prominent. Iris minutely speckled with gold, revealing a vertically elliptical pupil. Neck fairly evident. Body stout and rough from the strong keels on the costal scales. It is dull dorsally, glossy on the belly, including the last three costal rows. Belly rounded. Tail short, rather compressed at the base, and rapidly tapering to a subacute point. It is about one-fifth the total length of the snake.

Identification.—Ventrals at least three times as broad as the ultimate costal row, with three or more rows of costals visible each side, and a rostral in contact with four or five shields will indicate a Homalopsid. *Cerberus* is known from the other genera by the disintegrated parietal shields.

Habits.—Fluviatile, estuarine, and semi-marine.

Food.—Fish.

Breeding.—Viviparous.

Poison.—Very slightly poisonous. Innocuous to man.

Lepidosis—*Rostral* . Touching four shields. *Internasals :* A pair, subtriangular with apposed bases. *Præfrontals :* A pair. *Frontal :* Disintegrate posteriorly. *Parietals :* Disintegrate. *Nasals :* In contact behind the rostral. The nostril slit-like and superior. *Loreal :* Present, single. *Præoculars :* One. *Postoculars :* Two. *Temporals :* Small and scale-like. *Subocular s :* Present ; cutting off contact of all supralabials with the eye. *Supralabials.* Nine or ten ; the first seven entire. *Infralabials :* Seven. *Sublinguals :* Three pairs ; the median and posterior oblique and quite separated by small scales.

Costals : Longer than broad, rectiform, keeled. The vertebral row not enlarged ; the breadth of its scales about two-thirds their length, and about two-thirds the ultimate row. Ultimate row enlarged, the breadth of its scales subequal to their length. In 23 to 29 rows at midbody. Usually six (or four) rows less at a point two heads-lengths before the vent. The 5th row above the ventrals is absorbed in the first two steps, and the 4th at the third. *Ventrals* . Rounded. About three times the breadth of the ultimate row. *Anal :* Divided. *Subcaudals :* Divided.

Dentition.—*Maxilla :* Diacranterian. Præcranterian, kumatodont. Cranterian, not enlarged ; obliquely set ; grooved on their anterior faces. *Palatine :* Anododont, isodont, *Pterygoid :* Anododont, scaphiodont. *Mandibular :* Anododont, kumatodont.

Distribution.—India to Indo-China. Ceylon, Andamans, Nicobars, Malay Archipelago to the Philippines, and North Australia. Three species are known, one of which, viz., *rhynchops* occurs in Ceylon.

Cerberus rhynchops (Schneider).

(Greek " rhunchos " snout, and " ops " face.)

The Dog-faced Water Snake.

Sinhalese : " diyabariya " (Ferguson).

Synonymy.—*Hydrus rhynchops, H. cinereus, Elaps boæformis, Hurria schneideriana, H. bilineata, Coluber cerberus, C. obtusatus, Python rhynchops, P. elapiformis, Homalopsis cerberus, H. molurus, H. schneideri, H. rhynchops, H. boæformis, Cerberus cinereus, C. russelii, C. acutus, C. unicolor, C. boæformis.*

History.—Depicted by Russell in his first volume in 1796 on Plate XVII., and again in his second volume in 1801 on Plate XL. Christened by Schneider in 1799.

General Characters.—As indicated under the genus.

Identification.—The frontal which is partially, and the parietals which are wholly, broken up furnish an easy means of knowing the snake, but perhaps a more certain method is as follows : A snake which, when laid on its back, reveals well-developed ventrals at least three times the breadth of the last costal row, and at the same time shows three or more rows of costals on each side of the ventrals, will prove to be *Cerberus* or *Gerardia* among Ceylon snakes. The former has 23 to 27 scale rows at midbody, and the latter 17.

Colouration.—The back is bluish gray when the snake is submerged, lightish gray when dry. It is crossed by numerous ill-defined but conspicuous darker bars, involving one to two scales in the length of the snake, the intervals involving five to seven scales. These bars grow less distinct posteriorly, and the foremost are broken up into spots in some specimens. The dorsal colouration ceases abruptly about midcosta, and is replaced by buff subcostally and ventrally. The belly is buff, coarsely spotted, or dappled with deep greenish black. The head is coloured above like the back, and the gray is sharply defined just above the supralabials. The upper lip and chin are buff. A conspicuous dark postocular streak is prolonged backwards to the side of the forebody.

Habits.—(*a*) *Haunts:* It is eminently an aquatic species, usually inhabiting the brackish waters of tidal-rivers, creeks, and estuaries. Ferguson and Cantor say that it frequents fresh water also, and Cantor, Haly, and Flower all report it from the sea in close proximity to our coasts. I became acquainted with it in Burma, and frequently observed it in the waters of the channels connected with the tidal-river system, as well as in the Rangoon river itself. I frequently saw it swimming in the ebb and flood tides. It swims powerfully, usually allowing itself to be carried with the stream, but it sometimes anchors itself to a convenient bamboo stake, anchor rope, or submerged branch by its tail, and from this purchase swings about in the current on the lookout for fish passing by. As the tide ran out many were observed lying along the branches of the trees and bushes just above the water, and when hustled dropped off into the stream below. Numbers were left stranded on the mud flats by the receding tide, and in the teak yards nearly every bole harboured beneath it some of these snakes. I have seen it exhibit some intelligence in the following manner: Lying extended in the length of a nearly empty ditch, after a period of quietude, it flicks its tail round first on one side and then the other, in such a way as to make an unwary fish recede from the movement towards its head, when coming within sight the fish falls an easy victim to the manœuvre.

(*b*) *Disposition:* In spite of its forbidding appearance this is a peculiarly inoffensive reptile. Blanford and others have remarked upon its quiet nature, and I can support their observations. It does not usually take alarm when encountered, but will permit one to approach close enough to place a stick over it, and allow itself to be captured. In captivity it is a singularly uninteresting lethargic creature, allowing itself to be handled, and rarely betraying a malicious spirit. Drumming on the glass of the vivarium even when its nose is against the glass, usually evokes little, if any, response. In a tank it is hardly more interesting.

(*c*) *Striking Posture:* Taken at a disadvantage on land it will occasionally exhibit great activity and try to escape. When prevented from so doing it protrudes the tongue and hisses, and flattens itself on the ground. When held down by

a stick it will sometimes strike and bite viciously, and under such excitement emits a disagreeable odour not necessarily accompanied by a discharge of the cloacal contents. When picked up it wreaths itself with some force around the hand.

(*d*) *Nocturnal or Diurnal:* It appears to be completely diurnal.

(*e*) *Progression:* Its mode of progression is curious. The body is thrown forward in a curve in advance of the head, and the head subsequently advanced, the body being again thrown forward before the snake quite extends itself. It gives the impression of moving sideways.

Food.—It feeds exclusively and voraciously on fishes. About Rangoon on the mud flats, it frequently pursued a little fish commonly called the walking perch, from its mode of active progression on the mud by means of fins that are used as legs. I once found a large fish 8 inches in length inside a specimen measuring 3 feet 3 inches. I have also known an eel taken. I frequently saw *Cerberus* wriggling at the end of a fisherman's hook bated with a fish to the disgust of the angler.

Breeding.—(*a*) *The Sexes:* I have failed to discover any sexual differences in proportions or lepidosis.

(*b*) *Method of Reproduction:* Like all the other homalopsids I know it is viviparous in habit.

(*c*) *Season:* I found eggs with no trace of embryo in a gravid female in February at Rangoon. Three gravid females from Moulmein, captured between March 26 and April 4, 1900, contained sacs with embryos about 63 mm. ($2\frac{1}{2}$ inches) in length. A gravid female in Madras was found to contain many embryos in April, 1917. I had young very recently born, viz., 193 and 200 mm. ($7\frac{5}{8}$ and $7\frac{7}{8}$ inches) long in May and July, respectively.

(*d*) *Period of Gestation:* Not known.

Growth.—(*a*) *The Young:* Gunther extracted the brood from a gravid female, and found them 178 to 190 mm. (7 to $7\frac{1}{2}$ inches) in length. This taken with the lengths of my two specimens mentioned above shows that the young are about 177 to 203 mm. (7 to 8 inches) when born. They number from 8 to 26 in a brood.

(*b*) *Early Life:* I find the young double their length in the first year of life, and have about trebled it by the end of the second year. It would probably take another two years before specimens attained to 3 feet, and I have examples of such, 3 feet 1 inch and 3 feet 3 inches, in June from Burma.

(*c*) *Maturity:* Unfortunately I have lost my detailed notes regarding the length of my gravid females, so am unable to say when the species is sexually mature.

(*d*) *Maximum Length:* Most specimens range between 2 and 3 feet, and anything over this is unusual. The longest of which I am aware is that reported by Stoliczka from Burma, which was 1,270 mm. (4 feet 2 inches).

Lepidosis.—(*a*) *Typical—Rostral:* In contact with 4 shields, the rostro-nasal and rostro-labial sutures subequal; sometimes a partial median suture is seen in the upper part of the shield. *Internasals:* Two; sub-triangular; their bases apposed in the median line, the sutures between them equal to or rather greater than that between the præfrontal fellows, subequal to the internaso-præfrontal sutures. *Præfrontals.* Two: the suture between them subequal to the præfronto-frontal; in contact with internasal, loreal, and præocular. *Frontal:* In contact with 7 shields, frequently more or less disintegrated posteriorly. *Parietals:* Disintegrated into many parts. *Nasals:* In contact behind the rostral; touching the first labial only. *Loreal:* One. *Præocular:* One. *Postoculars:* One or two. *Temporals:* Replaced by small scales. *Suboculars*: One to three. *Supralabials:* Nine or ten; none touching the eye, the last three or four divided into an upper and lower part. *Infralabials:* Many, small. *Sublinguals:* Three pairs, the anterior in contact with 3 or 4 infralabials. *Costals:* Two heads-lengths behind the head 25 (rarely 23); midbody 23 to 25 (rarely 27); two heads-lengths before the anus 19 or 17. Where the rows are 25, they reduce to 23 and again to 21 by a fusion of the 4th and 5th, or 5th and 6th rows above the ventrals; from 21 to 19, the 3rd and 4th rows fuse. Strongly keeled in all rows, except the last, for a variable extent anteriorly. *Ventrals:* 132 to 160; well developed. *Anal:* Divided. *Subcaudals:* 49 to 72; divided. (Fig. 52.)

(*b*) *Anomalies:* Some of the subcaudal shields are rarely entire.

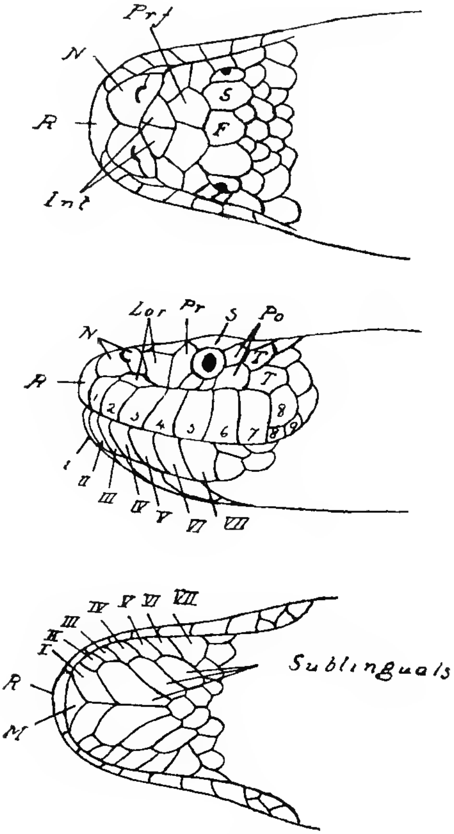

FIG. 52.—Cerberus rhynchops.
(×1½.)

Dentition.—*Maxillary:* Præcranterian, 15 to 16. Cranterian, a pair; grooved; not larger than the preceding. *Palatine:* 9. *Pterygoid:* 22 to 25. *Mandibular:* 20 to 23.

Distribution.—(*a*) *General:* Ceylon, Coasts of India, and tidal-rivers from Sind and Mekran on the western side to

Tenasserim. Indo-China. The Malay Peninsula, the Andamans, Nicobars, and Malay Archipelago to the Philippines, and the Pelew Islands.

(*b*) *Local:* It is an extremely common snake on the Indian littoral, especially on the Burmese coasts. Ferguson says it is a common snake in Colombo, and Haly endorses this remark.

Genus GERARDIA.

(Named in honour of Monsieur Gerard.)

General Characters.—As detailed for the species.

Identification.—The costals in 17 rows anteriorly and at midbody, 15 posteriorly, a single internasal, and one supralabial touching the eye will indicate the genus.

Habits.—Aquatic, fluviatile, estuarine.

Food.—Fish.

Breeding.—Nothing known.

Poison.—Feebly poisonous, probably quite innocuous to man.

Lepidosis.—As detailed under the species.

Dentition.—*Maxillary:* Diacranterian. Præcranterian small, anododont, isodont. Cranterian, represented by two pseudofangs, grooved on their anterior faces.

Distribution.—Coasts and estuaries of Peninsular India and Burma.

Gerardia prevostiana (Eydoux and Gervais).

(Named in honour of Monsieur Prevost, Superintendent of the Paris Museum when the snake was discovered.)

Gerard's Water Snake.

Synonymy.—*Coluber prevostianus, Gerarda tricolor, Campylodon prevostianum, Heleophis flavescens.*

History.—First referred to and figured by Eydoux and Gervais in 1837.

General Characters.—A small snake growing to about 2 feet. Head moderately depressed, about as broad as the body. Snout moderately long, obtusely rounded terminally, without canthus. Eye small, inclined upwards; pupil vertically elliptic. Nostrils latero-superior and valvular. Neck

little evident. Body rather robust, slightly depressed, attenuating anteriorly and posteriorly. Belly rounded. Tail short, being about one-eighth to one-ninth the total length.

Identification.—The costals are 17 anteriorly and to beyond the middle of the body, reducing to 15 (rarely 13) posteriorly. Only one supralabial touches the eye, and the rostral touches only 5 shields. Its recognition is therefore easy. It bears a distinct superficial resemblance to *Hypsirhina enhydris*, *H. plumbea*, and *Helicops schistosus*, but is easily distinguished if the lepidosis is relied upon.

Colouration.—Dorsally when wet the snake is a uniform dirty olive-green, when dry grayish. The belly is buff, and the last 3 costal rows yellow, outlined like the ventrals with dull olive-green. The head above is coloured like the back, and the lips are yellow.

Habits.—(*a*) *Haunts:* It is entirely aquatic, haunting tidal rivers and estuaries, and straying out along the coasts. It is sometimes left on the shore by the receding tide, and I encountered one so stranded in Cannanore. It was lying in a shallow pool of water, partly submerged. Nicholson records one which had wandered into a dusty street in Rangoon.

(*b*) *Disposition:* Apparently a lethargic snake on land, and disinclined to bite. The one I encountered took no notice of me though I walked right over it when out snipe shooting. When I confronted it, it made no attempt to break away, and was captured without trouble. It was a very hot day.

Food.—No observations have been made, but it is fairly certain to subsist upon fishes.

Breeding.—Nothing known.

Growth.—I took a half-grown specimen 318 mm. ($12\frac{1}{2}$ inches) long in Rangoon in June. Its maximum length, as given by Boulenger, is 520 mm. (1 foot $8\frac{1}{2}$ inches).

Lepidosis.—(*a*) *Typical—Rostral:* Touches five shields; the rostro-labial sutures longest. *Internasal:* A single shield separating the nasals. *Præfrontals:* A pair; the suture between them shorter than the præfronto-frontals; touching the internasal, nasal, loreal, præocular, and supraocular. *Frontal:* Touches six shields; the fronto-supraocular and fronto-parietal sutures subequal. *Supraoculars:* Nearly as

long as the frontal, about one-third the breadth of the frontal along a line connecting the centres of the eyes. *Nasal:* Entire. *Loreal:* One. *Præocular:* One; not reaching the top of the head. *Postocular:* Two. *Temporal:* One. *Supralabials:* Eight; the 1st touching the nasal, and the 4th the eye. *Sublinguals:* Two pairs; the posterior shorter, touching the 4th and 5th infralabials; quite separated by small scales. *Infralabials:* Five; the 5th largest, and touching two or three scales behind. (Fig. 53.)

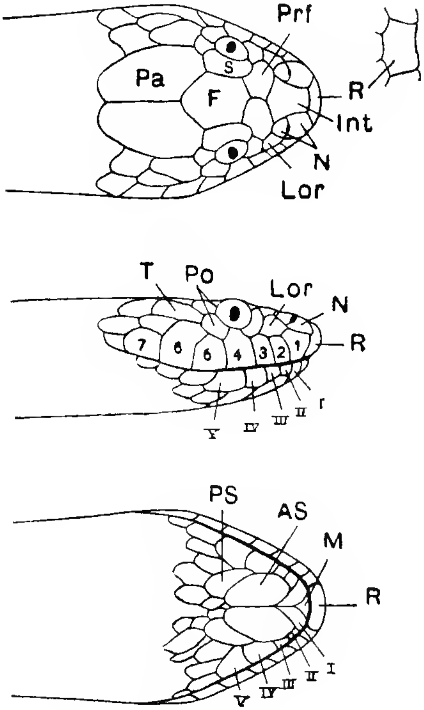

FIG. 53.—Gerardia prevostiana.
(× 1½.)

Costals : About as long as broad, rectiform, smooth, without apical pits. Vertebrals not enlarged, the breadth of its scales subequal to their length, and less than those of the ultimate row. Ultimate row with scales broader than long. In 17 rows to behind midbody, where they reduce to 15 by a fusion of the third and fourth rows from the ventrals. They further reduce to 13 before the vent by the blending of the sixth and seventh rows from the ventrals. *Ventrals :* 145 to 154 ; not keeled. *Anal :* Divided. *Supracaudals :* In even rows. *Subcaudals :* 30 to 34 ; divided.

(*b*) *Anomalies—Temporals :* Rarely two. *Supralabials :* Sometimes seven, with the 3rd and 4th touching the eye.

Dentition.—I have no skull.

Distribution.—(*a*) *General :* The coasts of India as far north as the Gulf of Cambay, on the western side, to the Burmese coasts. Boulenger (Catalogue of Snakes, Brit. Museum, Vol. III., p. 21) gives Ceylon as part of its habitat. Haly, in discussing doubts which had arisen before his day, as to whether this species occurred in Ceylon, says " the occurrence of *G. bicolor* (= *G. prevostiana, vide* synonymy) in Ceylon is set at rest by the capture of a specimen in the Kelani river by Mr. H. F. Fernando, which he presented to the Museum." When I visited Colombo Museum I examined a specimen (No. 99), which is probably the identical one referred to.

(*b*) *Local :* Seemingly a very rare snake in Ceylon. It is also a very uncommon snake round the coasts of India, judging from the dearth of specimens in Museums. There is one in the British Museum from Bombay, and two from Burma. Phipson mentions four obtained from the vicinity of Bombay, and I have had one specimen from Cannanore, another from Burma, and have examined another from Broach in the Gulf of Cambay. I saw no specimen in the Indian Museum, and it is perhaps singular that it has not been recorded from the eastern coast of India.

Sub-family 5 **Dipsadomorphiinæ.**

(Named from the type genus *Dipsadomorphus.*)

General Characters (from Indian species).—Head small to moderate, elongate or broad. Snout short, moderate, or long, with or without canthus, with or without a pointed rostral appendage. Eye moderate to large; the pupil round, horizontal, or vertical. Nostril lateral, small, or moderate. Neck moderately or strongly constricted. Body short, moderate, or elongate; cylindrical or compressed. Belly rounded or keeled. Tail short, moderate, or long.

Habits.—Terrestrial or arboreal. Active.

Food.—Mammals, birds, reptiles, batrachians.

Breeding.—Oviparous or viviparous.

Poison.—Feebly poisonous, the bite producing at the worst some trivial local effects and no constitutional symptoms.

Lepidosis.—Head covered with large shields, conforming to the Colubrine type. *Loreal:* Usually present. *Sublinguals:* Two pairs.

Costals: Longer than broad; rectiform or some of the lateral rows oblique; with or without apical pits; keeled or smooth. Vetebrals enlarged or not. *Ventrals:* Rounded or keeled. *Anal:* Entire or divided. *Subcaudals:* Divided.

Dentition.—*Maxillary:* Opisthoglyphous; isodont or anisodont; syncranterian or diacranterian; anododont, oinododont or dinododont; kumatodont or coryphodont. *Palatine:* Isodont or scaphiodont. *Pterygoid:* Isodont or scaphiodont. *Mandibular:* Isodont or anisodont; anododont, oinododont, or dinododont; scaphiodont.

Distribution.—Europe, Africa, America, Asia to the Philippines.

Of the many genera five are represented within Indian limits, and three in Ceylon.

Genus DIPSADOMORPHUS.

(Greek " dipsas "* a kind of snake, and " morpho " form, *i.e.*, like another genus to which the name *Dipsas* has been applied.)

General Characters (for Indian species).—The members of the genus have very distinctive characters, whereby they are easily recognized. They vary in length from about 3 to over 7 feet. Head subovate and markedly depressed; widest about midway between the eye and the neck. Muzzle short, with obtuse canthus, and obtusely rounded anteriorly. Eye large, with a vertical pupil. Nostril round, contained equally in the anterior and posterior nasals, and occupying about the median two-fourths of the depth of the suture between them. Neck markedly constricted, and this, taken with the shape of the head, leads many to suppose these snakes are vipers. Body markedly compressed, attenuating towards the neck and the vent. Belly rounded or obtusely angulate laterally. Tail cylindrical, varying from about one-fourth to one-fifth the total length.

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* *Dipsas* was applied to a snake whose indentity is now uncertain, but the name has been retained, and is now applied to a genus of South American snakes. The *dipsas* of the Ancients was reputed to be venomous, and, according to some, one of the effects of its bite was an insatiable thirst (Greek " dipsa " thirst), though Lucan makes it appear that it was the creature itself that was afflicted with thirst. Thus, in his Pharsalia, written in the first century A.D., he alludes to it on the occasion when Cato was leading his army across the desert. The passage has been thus translated :—

And now with fiercer heat the desert glows,
And midday gleanings aggravate their woes;
When, lo! a spring amid the sandy plain
Shows its clear mouth to cheer the fainting train,
But round the guarded bank in thick array
Dire aspics roll'd their congregated way,
And thirsting in the midst the dipsas lay.

Identification.—The compressed body, narrow neck, large eye with vertical pupil, the enlarged vertebral row of scales, and the entire anal shield (with rare exceptions, none of which are Ceylonese) constitute a syndrome, by which the representatives of the genus are easily recognized.

Habits.—Arboreal. Nocturnal. Active. Fierce, when provoked.

Food.—Small mammals, birds, lizards, batrachians.

Breeding.—Oviparous so far as is known.

Poison.—Feebly poisonous, producing at the worst some trifling local effects.

Lepidosis (for Indian species).—*Rostral :* Touches six shields. *Internasals :* A pair. *Præfrontals :* A pair. *Frontal :* Touching six shields. *Nasals :* Divided. *Loreal :* Present, shorter than the nasals. *Præoculars :* One to three. *Postoculars :* Two. *Temporals :* Two or three ; small, scalelike. *Supralabials :* Eight to ten ; three touching the eye. *Sublinguals :* Two pairs ; subequal, or the posterior rather shorter. *Infralabials :* The last about as broad as the posterior sublinguals, but shorter than those shields.

Costals : Longer than broad ; smooth or feebly keeled ; with apical facets. *Vertebrals :* Enlarged, rectiform ; originating on the nape by a confluence of three rows, terminating in the supra-anal region. Last three rows rectiform, progressively increasing in breadth. The rows between the third and the vertebral oblique, and their breadth about half their length. Ultimate row broadest. In 13 to 31 rows at midbody. *Ventrals :* Rounded. *Anal :* Entire or divided. *Supracaudals :* In even rows ; vertebrals not enlarged. *Subcaudals :* Divided.

Dentition.—*Maxillary :* Opisthoglyphous, diacranterian. *Præcranterian :* Feebly kumatodont. *Cranterian :* Two or three ; enlarged ; grooved on their anterior faces ; obliquely

set. *Palatine:* Anododont, strongly scaphiodont. *Pterygoid:* Anododont, scaphiodont. *Mandibular:* Anododont, strongly scaphiodont.

Distribution.—Tropical Africa, South Asia, Papuasia, Australia.

There are about twenty-eight species, of which seventeen occur within Indian limits, and five of these in Ceylon.

DIPSADOMORPHUS TRIGONATUS (Schneider).

(Latin. Adjectival form of "trigonum" a triangle, from the somewhat triangular dorsal marks.)

*The Gamma Snake or Common Indian Catsnake.**

Synonymy.—*Coluber trigonatus, C. sagittarius, C. catenularis, Dipsas trigonata.*

History.—First brought to scientific notice by Russell, who figured it in 1796 in his first volume on Plate XV. Christened by Schneider in 1802.

General Characters.—A small snake growing to about 3 feet in length. Head depressed; subcordate in shape, widest midway between the eye and the neck. Snout shortish, without canthus, obtusely rounded. Neck markedly constricted. Nostril lateral, almost wholly contained in the anterior nasal shield; occupying the second- and third-fifths of the suture from above downwards. Eye large, with mustard-yellow iris and vertical pupil. Body slender, elongate, and markedly compressed; attenuating towards the neck and the vent. Belly rounded. Tail moderate in length, being about one-seventh to less than one-sixth the total length.

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* The marks on the body are very like a Greek γ, especially those on the right side. I call the species of this genus the catsnakes because they are cat-like in the following traits: They are arboreal in habit, exhibit a fierce nature, are mainly nocturnal, and possess a large eye, with a vertical pupil and mustard-coloured or greenish iris.

Identification.—The scale rows 21 two heads-lengths behind the head, 21 in midbody, and 15 two heads-lengths before the vent will proclaim the species among Ceylon snakes

Colouration.—(*a*) Variety *typicus*—The ground colour is usually of a light yellowish-brown, sandy, or fawn hue, which may be uniform or more or less mottled with darker shades, especially low in the flanks, or sparsely scattered with black spots. Dorsally a series of dark, more or less distinct, y-shaped marks occur on each side, which fade posteriorly, ending at or before the vent. The shade between the arms of each "y" is lighter, often, indeed, whitish. Where the series of one side exactly meets the fellows of the other on the spine, as frequently happens in part, if not the whole length, of the body, these marks resemble arrowheads. The belly is pearly-white with small, circular, rufous, or brownish spots laterally. Blyth says the very young are pale with but slight traces of the adult marks, but I cannot say that my young specimens have been in any way different from adults. I have noticed that the skin between the scales is dun, and somewhat darker in the gamma marks, and in sloughs these marks are obscurely traceable. A specimen I got in Delhi was much the colour of *café-au-lait*, and was copiously speckled with very fine punctiform dark spots, the gamma marks being very obscure. The head bears a pair of large lung-shaped brown patches, often delineated with black, and a narrow dark streak passes from behind the eye towards the gape.

(*b*) Variety *melanocephalus* (Annandale)—Darker than the last, with a black head; and recorded only from the borders of Persia and Baluchistan.

Habits.—(*a*) *Haunts:* It is essentially arboreal in habit, frequenting bushes, scrub, or trees, usually in close proximity to the ground, though it will climb to considerable elevations at times. I have frequently come across its sloughs low down in lantana and similar tangled vegetation. It often descends to the ground, and I have several times met with it at night in the open, on the road, or a garden path. At these times it was always on the move, but I have

had several examples brought to me found coiled up on the ground beneath a bush, during the day time, apparently asleep.

In bushes it coils itself into a little heap, unlike the tree snakes of other genera, which recline with the body extended in graceful curves, distributing their weight on many points, unless they are actually resting in their major or full length along a suitable branch.

Nurse reports having frequently seen it in Guzerat, where it appears to be very abundant, curled up on the top of cactus hedges. It sometimes takes up its abode (perhaps for the deposition of eggs) in a hole in a tree trunk, and in one instance one had evidently recently tenanted a crypt in the crevices of a wall, as its slough was seen partly issuing from a hole in the face of the brickwork.

After the foregoing observations, it will appear remarkable that such a creature can adapt itself completely to a desert environment, but such is undoubtedly the case, for Blanford records one from Gwadar in Baluchistan, which, he says, is merely a fishing village on a barren spit of sand, between a rocky promontory and the mainland, where there is not a single tree and scarcely a bush to be found.

(*b*) *Disposition:* This with others of its genus is one of the most intrepid snakes I know. Often with no further provocation than being suddenly disturbed or confronted, it will assume an attitude of defiance, and, with little hesitation, will boldly act on the offensive.

(*c*) *Striking Posture:* The attitude it adopts at these times is very characteristic. The head and forebody are erected well off the ground, and the latter thrown into loops, of which two overlapping one another, are thrown to one side and one on the other, the head being poised in the middle of the figure-of-8 so formed. The rest of the body lies variably disposed in sinuous extension. Prior to its stroke the erected part is swayed slightly forwards and backwards, whilst the body is inflated and deflated with agitation, and the tail briskly vibrated with emotion. Poised thus, intently watching the

object of its alarm for a favourable opportunity to deliver its thrust, the little creature reminds one of the behaviour of a wrestler seeking with the utmost vigilance to engage his adversary advantageously. The stroke is delivered with great malice, the jaws opening widely in the act of striking, and the forward thrust is no sooner accomplished than the creature retracts itself to reassume its former attitude, and strikes again and again, in fact, will sometimes do so till its energies are spent. During the thrust the loops are straightened to their utmost, and a two-foot snake may dart at and strike an object six inches or even more in front of it.

I have several times tried to get this and others of this genus photographed in the peculiar attitude just referred to. The last occasion was in Fyzabad, but in my attempts to get the right pose, I was struck at again and again, until the specimen lay over on its side completely exhausted, and I picked it up with no more fight in it, and restored it to its box. The next day it repeated the same performance with a similar climax. Such determination and courage in so small a creature are worthy of the greatest admiration.

Its attitude before striking is very similar to that displayed by the pit vipers, *Trimeresurus gramineus* and *T. anamallensis*.

(*d*) *Nocturnal or Diurnal:* It is nocturnal in habit, and nearly all my specimens encountered on the move have been killed at night.

Food.—Like other ophidians the gamma snake takes almost anything it can get, but it shows a strong partiality in its natural haunts for lizards, especially those of the genus *Calotes* and other agamoid forms. Gunther says it feeds on mice, but I have known it do so on only one occasion. In captivity, Mr. Millard tells me, it feeds freely on small birds, lizards, and mammals, killing them by constriction in the same manner as the python. It would appear to be capable of utilizing its tail to some purpose in the same direction, for Russell relates the following experience : " In the month of December a vigorous subject of this species was made to bite a chicken, which he did very fiercely and repeatedly in different parts.

The chicken at first fluttered and screamed with pain, but soon became quiet. In about half a minute, greatly to my surprise, she let fall her head, and shut her eyes as if dead. The position of the wing prevented the cause of this being at first discovered. The snake imperceivedly had wreathed its tail round the chicken's neck, and the bird, had it not been rescued, would inevitably have been strangled. Soon after being disengaged, it recovered perfectly." Mr. D'Abreu says in captivity his specimens have taken lizards of the families *Agamidæ* and *Geckonidæ*, but refused the *Scincidæ*. He found a robin (*Thamnobia cambayensis*) in one specimen.

Breeding.—(*a*) *The Sexes:* According to my records females appear to be much more abundant than males. Females appear to grow to a much larger size than males.

The anal glands yield a nasty-smelling secretion, like custard in colour and consistency.

(*b*) *Method of Reproduction:* Mr. D'Abreu had a female at Nagpur that laid eggs in his vivarium.

I have had many egg-bound females with eggs in which, I thought, I found traces of very young embryos. Mr. D'Abreu confirms this by telling me his eggs contained minute embryos 7 mm. (about $\frac{3}{8}$ of an inch) long.

(*c*) *Season:* I had one egg-bound female in Almora in May, one in June, one in Fyzabad in July, two in Fyzabad and one in Saugor, C. P. (India), in August. Mr. D'Abreu's specimen oviposited on September 2.

(*d*) *Period of Gestation:* Not known.

(*e*) *Period of Incubation:* Not known.

(*f*) *The eggs:* The eggs vary in number from three to eleven. My largest eggs taken from the abdomen measured 30 mm. ($1\frac{5}{32}$ inch) in length, and 10 mm. ($\frac{12}{32}$ of an inch) in breadth. Those laid in Nagpur measured 26 to 29 mm. (1 to $1\frac{1}{8}$ inch) in length, and 12 to 13 mm. ($\frac{1}{2}$ an inch) in breadth. In a specimen, with a body 2 feet and $\frac{3}{4}$ of an inch in length, the eggs in a single string occupied $8\frac{1}{2}$ inches.

Growth.—(*a*) *Length of Hatchling:* The smallest specimens I have had measured 237 mm. ($9\frac{3}{8}$ inches) and 260 mm. ($10\frac{1}{4}$ inches). Both appeared to be hatchlings. The former was captured in Trichinopoly in March, and the latter in Banglore in July. Blyth records the measurement of the young as about 230 mm. (9 inches), but as he refers to a species attaining to a length of 6 feet, this statement does not inspire confidence.

(*b*) *Early Life:* The rate of growth is difficult to follow from my records. An unusual number of specimens range round about 2 feet in length in the months of June, July, and August, and would probably be two years old.

(*c*) *Maturity:* My smallest prospective dam measured 570 mm. (1 foot $10\frac{1}{2}$ inches) in length, and would appear to be about two years old.

(*d*) *Maximum Length:* I have already remarked that females appear to grow much longer than males. My largest male record is 655 mm. (2 feet $1\frac{3}{4}$ inch), but I have many female records in the vicinity of 915 mm. (3 feet). My largest female taped 940 mm. (3 feet 1 inch).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures are about twice the rostro-internasals and rostro-labials. *Internasals:* The suture between them is about two-thirds that between the præfrontals; two-thirds to three-fourths the internaso-præfrontals. *Præfrontals:* The suture between them is subequal to the præfronto-frontals; touches the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures are rather longer than the fronto-parietals. *Supraoculars:* Length subequal to the frontal, breadth about half the frontal along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreal:* About half to three-fifths the length of the nasals. *Præocular:* Not or barely reaching the top of the head. *Postoculars:* Two. *Temporals:* Two; very irregular in size and number. *Supralabials:* Eight; 1st and 2nd touching the nasals; 3rd, 4th, and 5th touching the eye; and the 6th and 7th the lower temporal. *Sublinguals:* Posterior subequal to or shorter than the anterior; quite separated by scales; touching the

last three or four infralabials. *Infralabials :* Seven ; the last shorter than the posterior sublinguals, about as broad as those shields, and touching three scales behind. (Fig. 54.)

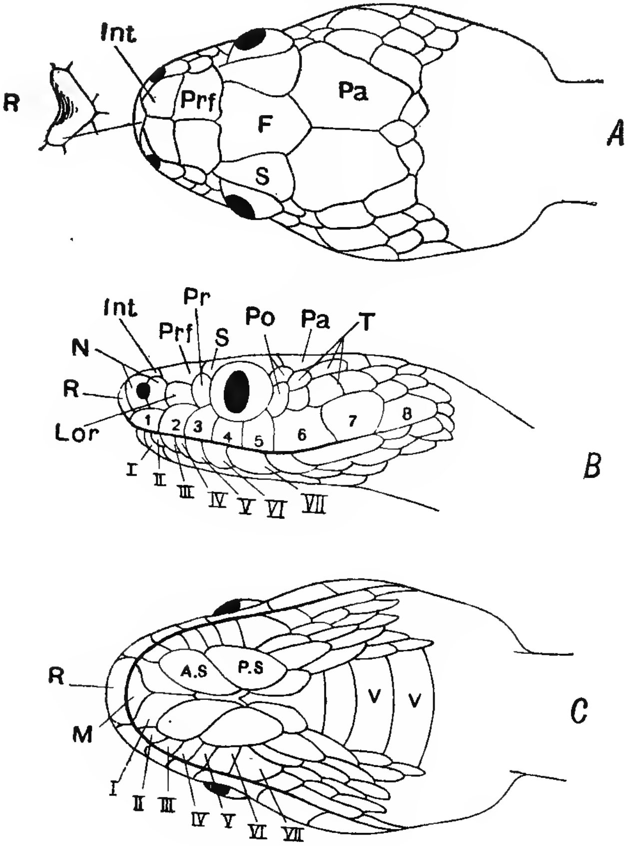

FIG. 54.—Dipsadomorphus trigonatus.
(× 2½.)

Costals : At midbody. Vertebrals, breadth of scales about two-thirds their length, and about two-thirds as broad as the ultimate row. Ultimate row, scales nearly as broad as long. In 21 rows to behind midbody, where they reduce by three

steps to 15 two heads-lengths before the vent. The rows reduce from 21 to 19 by the absorption of the uppermost row into the vertebral; from 19 to 17 by the fusion of the third and fourth rows from the ventrals; from 17 to 15 the uppermost row is again absorbed into the vertebral. *Ventrals :* In males 206 to 221, in females 218 to 256. *Anal :* Entire. *Subcaudals :* In males 79 to 96, in females 75 to 88; divided. (Figs. 55 and 56.)

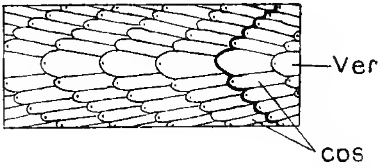

FIG. 55.—Scales of D. trigonatus seen from above.

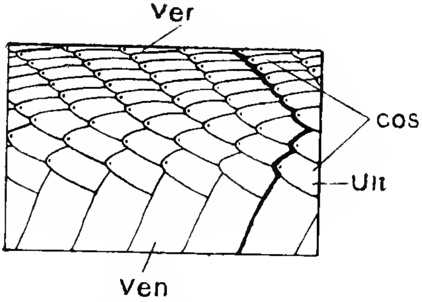

FIG. 56.—Dipsadomorphus trigonatus to show scaling.

(*b*) *Anomalies—Supralabials :* The second is rarely divided into an upper and a lower part. *Costals :* Rarely 23 rows. In one such specimen I noted that the fourth row from the ventrals divided, and reunited several times in the forebody. The steps of absorption may not occur in normal order. *Subcaudals :* A few of those near the base of the tail are sometimes entire.

Dentition.—*Maxillary :* Præcranterian, 8 to 10 ; Cranterian, 2. *Palatine :* 5 or 6, as long as the maxillary. *Pterygoid :* 7 to 10. *Mandibular :* 14 to 16. (Fig. 57.)

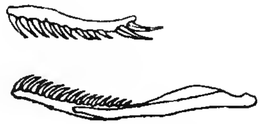

FIG. 57.—Maxilla and mandible of Dipsadomorphus trigonatus. (× 2.)

Distribution.—(*a*) *General :* Peninsular India to the Himalayas. On the north-west it extends beyond the borders of Persia to Transcaspia, and on the north-east to Assam. Ceylon.

(*b*) *Local :* It is a denizen of the plains, but ascends some altitude into hilly regions. I obtained several specimens from Almora in the Western Himalayas at about 5,000 feet elevation.

It is a fairly common snake in India, and probably commoner than its captures denote, for it is usually encountered on the ground, after leaving the protection of its arboreal environment. If seen in a tree it would almost certainly evade capture unless a gun were handy.

The fact that I found a specimen in a small collection made by Mr. Ormiston at Kalupahana, Haldummulla (about 3,000 feet), is interesting, for neither Haly nor Willey included the species in their lists, and Boulenger does not include Ceylon within the range of its habitat. Wm. Ferguson, however, wrote in 1877 : " of specimens sent to be named by Dr. Gunther, he is returning one named *Dipsas trigonata*." Since this date no mention of this species has been made, and, presumably, no specimen has come to light, since Haly, Willey, and Boulenger omit to mention it as a Ceylon snake, possibly thinking that Gunther was mistaken in his identification, or that the snake submitted to him had not really been obtained in this Island.

DIPSADOMORPHUS CEYLONENSIS (Gunther).

(Latin, implying a denizen of Ceylon.)

Gunther's Catsnake.

Sinhalese "mapila" (Ferguson).

Synonymy.—*Dipsas ceylonensis, D. hexagonota.*

History.—Described by Gunther in 1858.

General Characters.—A fair-sized species growing to 4 feet. The head, neck, and body conform to the characters specified under the genus. The tail is about one-fifth the total length.

Identification.—The scales 19 two heads-lengths behind the head, 19 in midbody, and 15 or 13 two heads-lengths before the vent will indicate the genus among Ceylon snakes. From *barnesi* it will be known by the single præocular and three supralabials touching the eye, and from *beddomei* by the ventrals not exceeding 243 and subcaudals 111.

Colouration.—Dorsally pale-brown, with a vertebral series of large dark-brown spots continuing on to the tail, the intervals involving about two vertebral scales. Usually a short, narrow, oblique stripe is given off from each spot laterally which passes backwards. There is an elongate nuchal streak, with a lateral streak beside it. The head has a pair of dark lung-shaped marks on the occiput, and a narrow, dark, postocular stripe passes to the gape. The belly is pale grayish or yellowish, with small specklings of brown and larger brown, lateral spots.

Habits.—(*a*) *Haunts:* Arboreal vegetation of all kinds. It frequently intrudes into man's immediate vicinity, taking up quarters in the garden, and is not infrequently met with on the creepers around the house. It was frequently disturbed in the Nilgiri Hills by estate coolies when plucking tea and coffee.

(*b*) *Striking Posture:* Similar to that evinced by its near relative *trigonatus*.

(*c*) *Nocturnal or Diurnal:* It is nocturnal in habit.

Food.—I have many records of its diet. These go to show that it favours a lacertine fare, frequently swallowing lizards of the genus *Calotes* and similar genera. It also frequently eats frogs, both arboreal and terrestrial. More rarely it devours birds. Mr. Pearless told me that he found one in his aviary once and killed it. It had eaten one of his canaries, and he had previously lost six other birds, always canaries or Java sparrows, which had disappeared mysteriously during the night.

Breeding.—(*a*) *The Sexes:* The male appears to grow much larger than the female, judging from my notes. My largest female record was 863 mm. (2 feet 10 inches), whereas I have had no less than nine males exceeding 1,015 mm. (3 feet 4 inches).

(*b*) *Method of Reproduction:* I have removed eggs from the abdomen of such a size and character as to leave little doubt that it is oviparous in habit.

(*c*) *Season:* Mr. Green sent me notes of an egg-bound female from Ceylon killed in May. I had two specimens in a similar state in the Nilgiris in August, and four in September. Another specimen with eggs from the Anamallay Hills was killed in September.

(*d*) *Period of Gestation:* Not known.

(*e*) *Period of Incubation:* Not known.

(*f*) *The Eggs:* I have frequently extracted eggs that were about 25 mm. (1 inch) long, my largest measuring 28 by 8 mm. ($1\frac{1}{16}$ by $\frac{5}{16}$ of an inch). They are remarkably elongate, white, soft shelled, and have the poles equally domed. In my nine gravid females the numbers have ranged between three and eight.

Growth.—(*a*) *The Hatchling:* My smallest specimen, which appeared to be very recently hatched, measured 317 mm. ($12\frac{1}{2}$ inches). This was killed in August in the Nilgiri Hills.

The only other specimen of that year's brood, also killed in August, was 432 mm. (15½ inches).

This last must have hatched out three months or more earlier. Four examples in the Colombo Museum vary from 287 to 326 mm. (11¼ to 12⅞ inches).

(*b*) *Early Life:* A long series collected in the Nilgiri Hills enables me to recognize the broods of successive years, and it is evident the young grow about ten or twelve inches a year. The average lengths in the months of July, August, and September being respectively 23, 34, and 44 inches.

(*c*) *Maturity* My smallest prospective dam measured 730 mm. (2 feet 4¾ inches), a length indicating that she was about eighteen months old.

(*d*) *Maximum Length:* My two largest specimens, both males, measured 1,283 mm. (4 feet 2½ inches). Abercromby mentions one 1,296 mm. (4 feet 3 inches), and Boulenger's outside measurement is 1,320 mm. (4 feet 4 inches).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures are about twice the rostro-labials, and more than twice the rostro-internasals. *Internasals:* The suture between them is rather shorter than that between the præfrontal pair, and rather shorter than the internaso-præfrontals. *Præfrontals:* The suture between them rather longer than the præfronto-frontals; touch the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures are rather longer than the fronto-parietals. *Supraoculars:* About as long as the frontal, and about half the breadth of the frontal along a line connecting the centres of the eyes. *Nasals:* Two. *Loreal:* Rather longer than deep, and about three-fifths the length of the nasals. *Præoculars:* One, reaching or nearly reaching the frontal. *Postoculars:* Two. *Temporals:* Two; small, variable, about half the length of the supraocular. *Supralabials:* Eight; the 1st and 2nd touching the nasals; 3rd, 4th, and 5th the eye; and 6th and 7th the lower temporal. *Sublinguals:* The posterior are about as long or onger than the anterior, quite separated by small scales, and

touching the 5th, 6th, and 7th infralabials. *Infralabials:* Seven; the 7th shorter than the posterior sublinguals, but about the same breadth; touching three scales behind.

Costals: Vertebrals, about as broad as long, and rather broader than those of the ultimate row. Ultimate row with scales rather longer than broad. In 19 rows to behind mid-body, reducing to 15 or 13 two heads-lengths before the vent. The reduction is due to an absorption of the third row from the ventrals once, and the uppermost row into the vertebrals at the other steps. *Ventrals:* 209 to 243 (Ceylon specimens 218 to 231). *Anal:* Entire. *Subcaudals:* 91 to 112 (Ceylon specimens 91 to 112). Taken together, the ventrals and subcaudals range from 311 to 342.

(*b*) *Anomalies.—Præoculars:* Sometimes two. *Supralabials:* Sometimes nine, with the 4th, 5th, and 6th touching the eye. *Costals:* The vertebrals occasionally disintegrate, and the count in consequence at such places will become 21. The scale rows should not, however, be regarded as 21 in these cases, as there is no supernumerary row strictly speaking. *Subcaudals:* Some of those at the base of the tail may be entire.

Dentition.—From four skulls in my collection. *Maxillary:* Præcranterian, 14 to 15 in Ceylon specimens, 18 to 20 in Nilgiri. *Palatine:* 7 to 8 in Ceylon specimens, 9 in the Nilgiri. *Pterygoid:* 18 to 20 in Ceylon specimens, and 19 to 21 in Nilgiri. *Mandibular:* 21 to 24 in Ceylon specimens, and 25 to 28 in Nilgiri.

Distribution.—(*a*) *General:* Hills in Southern India and Ceylon.

(*b*) *Local:* In the Nilgiris it is a common snake that favours an elevation between about 3,000 and 5,000 feet. In Ceylon it is evidently a fairly common snake, which, Willey says in a letter to me, extends about as far north as Sigiriya. I have had specimens from Kandy, Peradeniya, and Moragalla. Pearless records it from Badulla. One in the Colombo Museum is from Nanu-oya, another from Horana. All the specimens I saw in the Colombo Museum (except *barnesi* and *forsteni*), eight in number, conformed to this type.

DIPSADOMORPHUS BEDDOMEI Wall.*

(Named in honour of the late Colonel Beddome.)

Beddome's Catsnake.

Synonymy.—*Dipsadomorphus ceylonensis.*

History.—The snake figured by Seba in his Thesaurus in 1734, Plate XLIII., Fig. 4, appears to be this species. Described by me in 1909.

General Characters.—Similar to those of *D. ceylonensis.*

Identification.—See footnote below.

Colouration.—Pale-brown or grayish dorsally, with obscure dark-brown oblique streaks. There are no lung-shaped marks on the occiput. The belly is grayish, sparsely speckled with dark-brown, and with a few lateral spots of the same colour.

Habits.—Appears to agree with those of *ceylonensis.*

Food.—I have made no observations on its diet. All my specimens have been preserved in spirit.

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* In 1909 I published a note in the Records of the Indian Museum (pages 151, *et seq.*) upon certain "forms" of *Dipsadomorphus.* I expressed the view that *ceylonensis* (Gunther), as described in Boulenger's Catalogue (Vol. III., p. 66), includes four distinct "forms," and gave in tabular form the shield characters for each, upon which reliance is mainly placed in the separation of the species of this genus, viz., the costal rows and the numbers of ventral and subcaudal shields. I suggested that each deserved recognition as distinct "species." Dr. Annandale in a later issue of the same Journal (Vol. III., p. 281) dissented from my view. A further study of the question, and the acquisition of a much longer series of specimens, confirms the views I then voiced. Thus, *ceylonensis*, as conceived by me, is based on eighty examples, characterized by the scales being in 19 rows anteriorly to behind midbody, the ventrals 209 to 240 and the subcaudals 91 to 112. The aggregate of the ventrals and subcaudals is 311 to 342. This is the common "form" found in Ceylon.

I find, however, that another "form" occurs in Celyon with the same number of scale rows, but many more ventrals and subcaudals. In other words, it has many more vertebræ than typical *ceylonensis*, and I regard it as a distinct "species," though others may accord to it only the minor rank of subspecies or even "variety." It is a less common "form," and I have only seen twelve examples. The ventrals vary from 248 to 266, and the subcaudals 111 to 129. If taken together, the aggregate for ventrals and subcaudals is 362 to 390. To this I attach Beddome's name.

Breeding.—Nothing known.

Growth.—Grows to 1,065 mm. ($3\frac{1}{2}$ feet).

Lepidosis.—*Typical:* Head shields as detailed under *ceylonensis.*

Costals: Vertebrals about as broad as long, broader than the scales in the ultimate row. Ultimate row with scales rather longer than broad. In 19 rows to behind midbody, reducing to 15 or 13 two heads-lengths before the vent. The reduction of rows is due to the absorption of the uppermost into the vertebrals twice, and the fusion of the third and fourth rows from the ventrals once. *Ventrals:* 248 to 266. *Anal:* Entire. *Subcaudals:* 111 to 129. The ventrals and subcaudals taken together range from 362 to 390.

Dentition.—I have no skull.

Distribution.—(*a*) *General:* Hills in Southern India and Ceylon.

(*b*) *Local:* It appears to be rather uncommon in Ceylon. I have seen three specimens from Peradeniya, and I acquired a fine specimen in Kandy. It was not represented in the Colombo Museum when I examined the collection in 1920.

DIPSADOMORPHUS BARNESI (Gunther).

(Named in honour of Mr. Barnes.)

Barnes's Catsnake.

Synonymy.—Nil.

History.—Described by Gunther in 1869.

General Characters.—Very similar to those of *ceylonensis.* The tail is about one-fourth the total length.

Identification.—The costal rows 19 two heads-lengths behind the head to well behind midbody, 15 two heads-lengths before the vent, and the three præoculars will denote this species among Ceylon snakes.

Colouration.—Pale neutral tint dorsally, with a vertebral series of large pale spots, edged with purplish-brown. A series of large purplish-brown irregular spots in the flanks, the most anterior of which form oblique streaks. Head purplish-brown powdered with grayish. A broad postocular dark

streak to the gape, edged paler above. Labials powdered, except for their sutures, which are dark-brown. Belly dirty white, powdered with dark specks.

Habits.—Nothing known.

Food.—Nothing known.

Breeding.—Nothing known.

Growth.—Boulenger says the type is 550 mm. (1 foot 9⅝ inches). I have had a specimen 595 mm. in length (1 foot 11½ inches). Abercromby in one place (Snakes of Ceylon, page 78) says it grows to 21 inches, and in another (page 47) says he obtained a specimen 4½ feet long. Since his description of the snake seems to be a repetition of that given in Boulenger's Catalogue (Vol. III., pp. 73 and 74), the identification of his large examples seems open to question.

Lepidosis.—(*a*) *Typical—Rostral :* The rostro-nasal sutures are twice the length of the rostro-labials, and more than twice the length of the rostro-internasals. *Internasals :* The suture between them three-fourths that between the præfrontal pair, and about three-fourths the internaso-præfrontals. *Præfrontals :* The suture between them rather longer than the præfronto-frontals ; touch the internasal, postnasal, loreal, two præoculars, and supraocular. *Frontal :* The fronto-supraocular sutures little longer than the fronto-parietals. *Supraoculars :* About as long as the frontal, and about two-thirds the breadth of the frontal along a line connecting the centres of the eyes. *Nasals :* Two. *Loreal :* Longer than high, about three-fourths the length of the nasals. *Præoculars :* Three, the upper hardly reaching the top of the head. *Postoculars :* Two. *Temporals :* Two ; small, half the length of the supraocular. *Supralabials :* Eight ; the 1st and 2nd touching the nasals : 4th and 5th the eye ; and 6th and 7th the lower temporal. *Sublinguals :* The posterior rather shorter than the anterior, quite separated by small scales ; touching the 4th and 5th infralabials. *Infralabials :* Five ; the 5th shorter than the posterior sublinguals, about as broad as those shields, and touching two scales behind.

Costals : Vertebral row with scales about as broad as long, and as broad as the ultimate row. Ultimate row with scales about as long as broad. In 19 rows to behind midbody,

reducing to 15 two heads-lengths before the vent. The reduction steps occur close together, and in one step the uppermost row is absorbed into the vertebral, and in the other the third and fourth rows from the ventrals coalesce. If a third step occurs, it is the uppermost row again that is absorbed into the vertebral. *Ventrals:* 214 to 220. *Anal:* Entire. *Subcaudals:* 98 to 100.

(*b*) *Anomalies—Supralabials:* The third only just fails to meet the eye in the three specimens I have examined, and it seems likely. therefore, that some examples will occur with three touching the eye, as one sees in most other species.

Dentition.—I have no skull.

Distribution.—(*a*) *General:* Peculiar to the hills of Ceylon. The type was taken by Mr. Barnes on Gangaruwa estate.

(*b*) *Local:*—Evidently a rare snake. Only the type existed in the British Museum when Boulenger's Catalogue appeared. I have examined this, and seen two other specimens which I refer to this species.

DIPSADOMORPHUS FORSTENI (Dumeril and Bibron).

(Named in honour of Mr. Forsten.)

Forsten's Catsnake.

Sinhalese: "mapila" (Ferguson); "le polonga" (blood snake) (Willey).

Synonymy.—*Triglyphodon forsteni, T. tessellatum, Dipsas forsteni, D. tessellatus, D. cynodon.*

History.—Described by Dumeril and Bibron in 1854.

Identification.—The scale rows 25 to 27 at midbody with enlarged vertebrals will denote this species.

General Characters.—A remarkably fine snake of handsome proportions, growing to over 7 feet. Its characters conform in every way to those mentioned under the genus.

Colouration.—Very variable, some specimens being notably light with few markings, others dark with very fine specklings and bold mottlings. Dorsally the ground colour is dirty-whitish or buff, and this is finely powdered or marbled with pale neutral tint or brownish. Usually there is a series of more or less distinct large purplish-brown cross-bars, most conspicuous anteriorly and extending from the nape well down the tail. In some specimens a series of lateral vertical marks alternate with the vertebral series, and there may be another series of smaller alternating spots below this. All such markings are most conspicuous and regular anteriorly, and gradually dissolve posteriorly into an irregular coarse mottling. Willey says in Ceylon there are two varieties "the typical variety, brown, with angular oblique black bars; and the red variety, uniformly rich reddish-chocolate above, without black bars, paler roseate flush below." The belly is dirty-whitish or yellowish, more or less speckled or mottled with dark tones, especially laterally. The head is powdered with pale neutral tint or brownish. In my experience hardly two specimens are alike. One large example in the Colombo Museum is a perfectly uniform light-brown.

Habits.—(*a*) *Haunts:* It is entirely arboreal in habit, and I think more usually lives in large trees than in low bush. Visiting the Maharajah of Balrampur some years ago, I found some very fine specimens displayed by his professional snake catchers, who assured me that they lived in pairs, and frequented holes in the "mohwa" trees (*Bassia latifolia*), in which they were quite common. I was told that it occasionally comes into the bungalows there. The record specimen was killed in the camp of Sir J. Campbell at Kaladungi, in the Naini Tal District. It came down from a tree near his servants' tent at night, and was killed, and another was killed in the same spot on the following night. Mr. N. Warde wrote to me from Manbhum, Lower Bengal, where he says they are common, that "it coils itself into a bundle at the end of a thin branch, round leaves and small twigs, and waits for birds."

(*b*) *Disposition:* It has been described to me as a fierce snake, especially by the snake catchers at Balrampur, and what I saw for myself amply confirmed this.

(c) *Striking Posture:* This is very typical of that displayed by all the members of the genus with which I am acquainted. The forebody is raised off the ground, and retracted into figure-of-8 loops, two superimposed and thrown to one side, and one on the opposite side. The head is retained in the middle line. While thus poised the snake inflates itself very considerably. Suddenly a lunge forward straightens the loops, the jaws are quickly opened, and as quickly close on the object of its anger. The snake then re-adopts its attitude of menace.

(d) *Nocturnal or Diurnal:* It is nocturnal in habit, and on this account appears to be a more uncommon snake than is probably the case.

Food.—Mr. N. Warde tells me that it is a voracious poultry eater, and also robs his pigeon houses, ascending by the one smooth supporting post. One invaded one of his servants' quarters at night, and caused a considerable stir among the inmates. When the neighbourhood was thoroughly awakened, and he advanced into the room, he found the snake in the act of swallowing a white fowl, and it continued to swallow with apparent unconcern, in spite of the assembled throng of spectators. A specimen brought to me in Berhampore (Orissa) had fed on a large bat. One in captivity in Bombay ate freely the lizards *Calotes versicolor* offered to it, and sparrows, and on one occasion a mouse.

Breeding.—(a) *The Sexes:* No special observations have been made on the sexes.

(b) *Method of Reproduction:* Said to be oviparous. Abercromby says eggs have been deposited in his vivarium. The Balrampur snakemen also assured me it lays eggs.

(c) *Season:* Abercromby records the laying of eggs in August and September.

(d) *Period of Gestation:* Not known.

(e) *Period of Incubation:* Not known.

(f) *The Eggs:* The Balrampur snakemen told me it lays from seven to nine eggs in the hot weather. Abercromby gives us no details of the eggs deposited in captivity.

Growth.—(a) *The Hatchling:* Nothing known. The smallest specimen I am aware of was 525 mm. (1 foot $8\frac{3}{4}$ inches) in September, and killed in the Nilgiris.

(*b*) *Maximum Length:* Abercromby (Snakes of Ceylon) says in one place it grows to 1,474 mm. (4 feet 10 inches) (page 79), and in another 2,050 mm. (6 feet 8¾ inches) (page 47). Sir J. Campbell sent me the skin of one specimen killed in his camp to identify, and it measured 2,312 mm. (7 feet 7 inches).

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal and rostro-labial sutures subequal, and about half the rostro-internasals. *Internasals:* The suture between them half that between the præfrontal pair, half or less than half the inter-naso-præfrontals. *Præfrontals:* The suture between them rather longer than the præfronto-frontals; touching the internasal, postnasal, loreal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures rather longer than the fronto-parietals. *Supraoculars:* As long as the frontal, about half the breadth of the frontal along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreal:* Little longer than deep, about three-fifths the length of the nasals. *Præocular:* Reaching the top of the head, but not touching the frontal. *Postoculars:* Two. *Temporals:* Three; small, half the length of the supraoculars. *Supralabials:* Eight or nine; the 1st and 2nd touching the nasals; 3rd, 4th, and 5th, or 4th, 5th, and 6th touching the eye; and the 6th and 7th, or 7th and 8th touching the lowest temporal. *Sublinguals:* The posterior subequal to the anterior, quite separated by small scales; touching the last three or four infralabials. *Infralabials:* Seven or eight, the last about as broad as the posterior sublinguals, but much shorter than those shields, touching two scales behind.

Costals: Vertebral gradually developed in the neck, and not the confluence of three rows; breadth about two-thirds their length, about two-thirds the breadth of the ultimate row. Ultimate row with scales rather longer than broad. In from 25 to 31 rows in midbody. *Ventrals:* 254 to 270. *Anal:* Entire. *Subcaudals:* 103 to 131.

(*b*) *Anomalies—Internasals:* Rarely three, in a transverse series. *Loreal:* Rarely touches the internasal; rarely duplicated, one shield lying behind the other. *Supralabials:* Sometimes ten. *Infralabials:* The first is rarely divided.

Dentition.—From three skulls in my collection. *Maxillary:* Præcranterian, 10 or 12. Cranterian, 3; all grooved on their outer faces, and progressively decreasing in length. *Palatine:* 6 or 7. *Pterygoid:* 9 to 11. *Mandibular:* 17 to 19.

Distribution.—(*a*) *General:* Hills of Peninsular India, including the Himalayas. Plains of Lower Bengal. Plains of Ceylon.

(*b*) *Local:* All my Indian specimens have been collected in the hills, or the near vicinity of hills. In Southern India I consider it an uncommon snake. Along the foot hills of the Himalayas it is seemingly uncommon also. In Lower Bengal, about Manbhum, Mr. Warde tells me it is common, and he reckoned he had killed probably fifty in fifteen years. Stragglers are occasionally met with some distance from hills.

In Ceylon it appears rather uncommon. Haly records it from Kalutara and Negombo, and I have had it from Henaratgoda. Willey records it from Horana and Anuradhapura. Mr. Drummond-Hay tells me it was common at Galatura (below 500 feet) during floods, where he noticed it in low trees at the edges of swollen rivers. He says Mr. Swayne killed one in his cardamom house on Massena estate. He has not seen it up-country.

Genus DRYOPHIS.

(Greek "drus" tree, and "ophis" snake.)

General Characters (from Indian species).—The species vary from about 2 to 6 feet in length. Head moderately depressed, narrow. Snout long, with pronounced canthus, rapidly narrowing to an acute extremity, with or without a pointed epidermal appendage. Eye rather large; iris powdered with gold; and pupil horizontal. Nostril small, pierced in the back of a single shield. Neck very evident. Body moderately or extremely slender, moderately or very

elongate; remarkably compressed in life, cylindrical after death. Belly rounded. Tail cylindrical, moderately or very elongate, being one-fourth to three-fifths the total length.

Habits.—Arboreal, diurnal, active.

Food.—Small mammals, birds, lizards, batrachians.

Breeding.—Viviparous as far as known.

Poison.—Slightly poisonous, sometimes producing trifling local effects, but no constitutional symptoms.

Lepidosis.—*Rostral:* Touches six shields. *Internasals:* A pair. *Præfrontals:* A pair. *Frontal:* Touches eight shields. *Nasals:* Entire. *Loreals:* None in some species, one to four in others. *Præoculars:* One. *Postoculars:* One or two. *Temporals:* One or two, small, scale-like. *Supralabials:* Seven to nine. *Sublinguals:* Two pairs; the posterior subequal to or longer than the anterior. *Infralabials:* Six, the 5th and 6th subequal, 6th shorter than the posterior sublinguals, but much broader than those shields; extending further back than the posterior sublinguals; touching two scales behind.

Costals: Longer than broad, without apical pits, smooth, except a few of the median rows over the anal region, which have mammillated keels. Vertebral and ultimate rows rectiform, the intervening rows oblique. Vertebrals enlarged, originating gradually on the nape and ending over the vent. Last two rows progressively increasing in breadth. In 15 rows at midbody. *Ventrals:* Rounded. *Anal:* Divided. *Supracaudals:* In even rows. *Subcaudals:* Divided.

Dentition.—*Maxillary:* Diacranterian, dinododont. Præcranterian, oinododont, anisodont. Cranterian, two; twice as long as the immediately preceding, and grooved on their outer faces. *Palatine:* Anododont, isodont. *Pterygoid:* Anododont, scaphiodont; posterior two-fifths edentulous. *Mandibular:* Oinododont; prænodal. coryphodont; postnodal, small, kumatodont.

Distribution.—South-eastern Asia.

There are eight species, two or which occur in Ceylon, viz., *mycterizans* and *pulverulentus*.

DRYOPHIS MYCTERIZANS Linné.

(Greek " mucterizo " I turn up the nose.)

The Common Whipsnake.

Sinhalese : " ehetulla " and " esgulla " (eye plucker) (Green). *Tamil :* " kan-kuthi-pambu " (eye thrusting snake), " pachay pambu " (green snake), " komberi mookan " (snouted branch climber).

Synonymy.—*Coluber mycterizans, C. nasutus, Dryinus mycterizans, D. nasutus, D. oxyrhynchus, D. russellianus, D. fuscus, Passerita mycterizans, P. fusca, Dryophis pavoninus, D. nasutus.*

History.—It was christened by Linné as far back as 1754, and figured by him. Russell remarked upon it in 1796, and figured it twice in his first volume (Plates XII. and XIII.).

General Characters.—Grows to over 6 feet in length. Head moderately depressed ; broadest just before the neck. Snout elongate, narrowing rapidly to a terminal point, like the bows of an outrigger ; terminating in a projecting epidermal appendage, with a prominent raised canthus. Loreal region markedly concave. Eye rather large, iris powdered with gold. It is set with a decided inclination forwards, which permits a practically uninterrupted range of vision anteriorly. The horizontal pupil allows light to impinge on the retina from a point far behind the eye. I estimate the field of vision as extending through an arc of about 330°. Nostril small, round, pierced in the back of the nasal. Neck very evident. Body long and very slender, markedly compressed in life, round after death ; attenuating to the neck and posteriorly. Belly rounded. Tail cylindrical, very long, being sometimes in males more than one-third the total length, and longer relatively than in any other Indian snake,

except the next species. Tongue pale pinkish, with white tips. Mouth pale pinkish inside.

Identification.—The horizontal pupil will proclaim the specimen one of the species of *Dryophis.* The appendage at the point of the snout is only seen in two of these, viz., *mycterizans* and *pulverulentus.* The former has always lateral white stripes running along the belly, which are not present in the latter.

Colouration.—Variety (*a*) *typicus* (Linné): The upper parts of the head, body, and tail are bright verdant-green, and the surface of the scales dull. The belly is of an equally intense but lighter shade of green, and is adorned on each side by a well-defined, narrow, white (sometimes bluish) stripe situated on the ventral shields. In ordinary circumstances the dorsal green is uniform, but under excitement, owing to the separation of the scales, a very beautiful chequered ornamentation of black and white is revealed in the anterior two-thirds of the body, which gives a very striking appearance to the snake. Viewed closely, the black and white ornamentation consists of squares arranged in echelon, those of one side meeting those of the other at an angle directed forwards. These hues are seen to be almost entirely confined to the skin, but they also narrowly tip the lower edges of the scales. The chin and throat are white, with light sky-blue and yellow mottlings. It is a remarkable fact that there is no green pigment responsible for the brilliant colouring of the snake. If the scales are viewed through a lens, they are seen to be studded with minute specks of bright yellow, and as the skin is of a bright blue colour the yellow specks convert this into green. The yellow pigment present is soluble in spirit, and imparts its colour to this fluid. It is also soluble in hot water, for if the skins are boiled, they lose their pigment and become blue, whilst the water becomes tinged with yellow. In most specimens the throat will show patches of sky-blue where not overlaid with this yellow pigment. The blueness of the skin, when robbed of its yellow, is due to a colour effect, and not to a blue pigment. Light passing through the translucent epithelium is broken up, the blue rays only being reflected, whilst the other

coloured rays are absorbed. The blueness of the sky, the sea, and substances like sulphate of copper, &c., is similarly produced.

Variety (*b*) *fuscus* (Dumeril and Bibron): In this variety the green is replaced by a sombre garb of khaki or olive-brown.

Variety (*c*) *tephrogaster* (Wall): Similar to *typicus*, but with the belly between the two lateral stripes cinereous-gray.

Variety (*d*) *rhodogaster* (Wall) : Similar to the last, only with rose or pale buff between the ventral stripes.

Variety (*e*) *rhodonotus* (Wall): A specimen in Mr. Drummond-Hay's collection is a beautiful rose-pink dorsally with pinkish-buff ventrally. This was taken at Galatura estate (500 to 1,000 feet). Mr. Drummond-Hay assures me this colour is not the result of the preservative in which it was placed, and that it is almost the same colour as in life, but perhaps not so bright.

Habits.—(*a*) *Haunts*: It is most frequently met with on low bushes and scrub, but will ascend trees. I have known it encountered by toddy collectors in high coconut palms on more than one occasion. It usually reclines on the topmost boughs of bushes, and in such a situation would generally pass for a green twig, and escape notice. Doubtless, many a bird and lizard is seized before being aware of its captor's presence in such a situation. In the vivarium it seems disinclined to move much, but all collect together, and recline in a tangled mass with their forebodies usually free, either motionless or gently swaying.

(*b*) *Disposition :* By some it is reputed to be a very gentle snake (Boulenger, Flower, Malcolm-Smith, &c.), and Ferguson implies the same thing when he says that in Travancore it is the only snake the ordinary native is not afraid to handle. His next sentence, however, seems to contradict this when he says : "Boys often bring them in, having first taken the precaution to tie up the head in a bundle of rags." I have had them frequently brought to me in the same manner, and there is no doubt this is due to the vicious nature of the snake. I have kept it in captivity in numbers, and when freshly caught, I find it not only menaces, but repeatedly strikes

at anyone confronting it. I have many times seen jugglers bitten by their captive specimens. Young are just as plucky as old specimens, and will repeatedly dart at any face placed near to the glass of the vivarium. The repetition of this thrust in a short time damages the nasal appendage, and makes it appear as if covered with many small scales, hence Annandale's pseudo-variety *anomalus* (*vide* footnote *). Green says when pressed it will strike out blindly, often in the direction of the face of its opponent. Millard writes to me : " It is when freshly caught very fierce and bites freely."

Natives in India and Ceylon believe that it strikes at the eyes of persons when confronted with them at close quarters, hence the Tamil and Sinhalese names for it. In this connection it is interesting to note that Finn, when holding two specimens, was bitten by one that struck at his eye, making two punctures on the upper, and one on the lower lid. Subsequently, on rubbing the lower lid, he removed a tooth from the wound. Green, again, says of one that it repeatedly struck at his face, though it would not take any notice of his hand. It also struck repeatedly at the eye pieces of a pair of binoculars.

(*c*) *Striking Posture:* When moderately alarmed it emits the tongue from closed jaws, and vibrates the tips. Whilst the tongue is thus retained, the snake rears its head and forebody, and dilates the forebody so as to bring conspicuously into view the very striking black and white chequering of the skin. If further excited it opens the jaws widely, and expands the lower jaw laterally in a very remarkable manner, so that the jaw, naturally shaped like the bows of a slender boat, becomes shovel-shaped. The mandibles are separated by strong muscular action to about twice their usual breadth, and the edges of the lower lips are simultaneously turned down. While menacing, the neck and forebody are much

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* *Anomalus* (Annandale).—This is not a valid variety. It was described by Annandale as peculiar in having the nasal appendage broken up into small scales as one sees in the species *Dryophis pulverulentus*. Subsequently, however, the condition was found to be due to traumatism, the specimens in captivity acquiring the peculiarity by damaging their noses against the glass of the vivarium.

compressed, and the throat is pouched. The tongue is meanwhile kept retracted and invisible, but the opening of the windpipe alternately dilates and contracts. Seen under these conditions, with the head retracted and the forebody thrown into sigmoid curves, the snake presents a most formidable aspect.

This and its near allies of this genus are the only snakes I know that menace with open jaws.

(*d*) *Diurnal or Nocturnal:* The common whipsnake is completely diurnal, a habit it enjoys by virtue of its colouration which harmonizes perfectly with its environment.

(*e*) *Progression:* When seriously disturbed it can move at a wonderful turn of speed over the foliage. Its body is so slender and so light that by distributing its trifling weight on many points it is capable of gaining support from the minutest twigs and twining stems. I have seen its pursuers running along a hedge find some difficulty to keep up with it. On the ground it moves much less speedily and makes off for the nearest tree or bush.

(*f*) *Hissing:* I have never heard this snake hiss, and snake charmers assure me that it does not do so.

(*g*) *Sloughing:* One caged in the Madras Museum cast its skin about once a quarter, the exact dates given me being May 28, August 9, and October 25, 1896. Green remarks of one that he had in captivity that it moulted four or five times during a confinement of about six months. Green's young born in the vivarium were observed to desquamate on the eighth day after birth. Kinnear's cast their skins on the second day after birth.

I have found and examined the sloughs, but have failed to find any marks indicative of the black and white chequering of the skin previously remarked upon.

Food.—Its tastes are very varied. Mice, birds, and lizards are all frequently devoured, and sometimes frogs and other snakes are preyed upon.

One in captivity in the Madras Museum ate 44 mice and 6 green frogs in one year. Millard says in captivity it eats mice, sparrows, geckoes, and the common lizard *Calotes versicolor*.

Green says that young in his vivarium readily fed on lizards of the families *Geckonidæ*, *Agamidæ*, and *Scincidæ*. He offered them grasshoppers, but never observed one taken. I have several records of birds being eaten, and there can be no doubt the whipsnake must be a frequent source of alarm to parent birds with a family to rear. I have only one record of a frog being taken in a state of nature, viz., a *Rana tigrina*, and it is perhaps singular that there is no record of arboreal frogs being eaten. Primrose recorded one swallowing a snake, viz., the buff-striped keelback (*Amphiesma stolata*), and I have known the snake *Rhinophis sanguineus* taken once. Mr. Kinlock has recorded one eating one of the *Silyburidæ*, and the Rev. J. F. Caius says that in captivity it frequently eats snakes, and mentions *Helicops schistosus*, *Nerodia piscator*, *A. platyceps*, and *Polyodontophis collaris*, among others. Green says : " Its manner of capturing its prey is invariable. When a lizard is introduced into the cage the snake slowly frees the forepart of its body and coils itself in zig-zag fashion. Then, suddenly darting forward, it seizes the victim unerringly just behind the head, drags it from its support, and keeps it dangling, without shifting its hold, but gradually tightening its grip, until the lizard is suffocated. This process takes perhaps 20 minutes in the case of a *Calotes*. The snake never commences to swallow its prey until all signs of life have ceased." I have known one take 36 minutes to seize and swallow a frog. When first seized the frog by its exertions turned the snake over and over, but, in spite of this rough treatment, the snake maintained its grasp. The frog continued to kick convulsively after the grasp had been transferred to its head, and until it had been completely engulfed.

Father Bertram, S.J., in a little pamphlet written for private circulation, says : " It does not even always wait for its prey to be paralyzed before eating it." I find, as in the instance narrated above, the victim is often by no means dead when swallowed, but is always held tenaciously until its struggles are of little avail. When the victim has passed through the jaws, the snake rears the anterior half of the body, and then practises a series of contortions, during which the body is thrown into shallow lateral undulations. The curves

of the undulations are rhythmically reversed with much muscular effort, with the effect that the mass is speedily passed on to the stomach.

Growth.—(*a*) *Length at Birth:* When born the young vary from 260 to 390 mm. (11 to 15 inches). One measured by Green in Ceylon was 330 mm. (12¾ inches). One measured by Kinnear in Bombay was 335 mm. (13 inches). Mr. Nair writes to me of two broods born at Trivandrum, the young of which varied from 280·5 to 330 mm. (11 to 12¾ inches). A specimen in Madras gave birth to three, one of which measured 342 mm. (13½ inches). I have removed fœtuses from the dead mother that taped 335 mm. (13 inches) on two occasions, and on another these varied from 320 to 370 mm. (12¼ to 14½ inches). One in the Colombo Museum measures 311 mm. (12¼ inches). Ferguson, however, reported young-born at Trivandrum 440 mm. (17 inches) long.

(*b*) *Early Life:* From a long series collected in the Nilgiri Hills it is evident that the young approximately double their length in the first year of life, being then from 23 to 32 inches long. They continue to grow at the same rate during the second year, at the end of which they measure from 39 to 47 inches.

(*c*) *Maturity:* My smallest mothers measured 46½ and 47 inches respectively, and Blanford has recorded one 44 inches long. These measurements show that maturity is reached by the end of the second year of life.

(*d*) *Maximum Length:* It frequently grows to 1,525 mm. (5 feet). I have had exceptional specimens 1,779 mm. (5 feet 10 inches) and 1,842 mm. (6 feet and ½ an inch). Kinnear has recorded two gravid females measuring respectively 1,779 mm. (5 feet 10 inches) and 1,944 mm. (6 feet 4½ inches).

Breeding.—(*a*) *Sexes:* Females attain to a greater length than males. I have eight records of females exceeding 1,525 mm. (5 feet), and two exceeding 1,830 mm. (6 feet). On the other hand, I have only two records of males exceeding 50 inches, viz., 1,288 and 1,295 mm. (50¾ and 51 inches).

The tail in the male is relatively longer than in the female.

It is further remarkable that in nearly all females the scales posteriorly reduce to 13 only, whereas in males the scales reduce to 11. I find very few exceptions to this rule.

(*b*) *Method of Reproduction:* This whipsnake is known to be viviparous in habit. It not infrequently happens that some of the young are born in membranes, but they usually are born free fi om the caul.

(*c*) *Season:* From available records the season for the appearance of the young is from March to December. One brood in Trivandrum was deposited on March 31. Green had one brood in April, and another was deposited in the same month at Trivandrum. Green had two broods in May. A dead specimen I opened in Burma in May contained fœtuses 335 mm. (13 inches) long. Evans killed one in Burma in May containing young, evidently on the point of being born. Kinnear reported two broods born in Bombay in August. I had two prospective mothers in the Nilgiris in September with young in a very advanced stage of development. Ferguson's brood were deposited on September 27. I have several other records of gravid females with eggs in an early stage of development in July, August, and September. One in the Madras Museum deposited three young on December 3, 1917.

Green observed two in his vivarium "in coitu" in June.

I have had young specimens measuring 410 mm. ($15\frac{7}{8}$ inches) and 480 mm. ($18\frac{1}{2}$ inches) in the Nilgiris in August, and one 440 mm. (17 inches) in Cannanore in November.

(*d*) *Period of Gestation:* This is not known. Ferguson's dam captured on June 30 produced her young on September 27 (89 days later), so that the period of gestation cannot be less than three months. From analogy it will probably be found to be five or six months.

(*e*) *The Brood:* This varies fiom 3 to 22. I have twelve records in which the young numbered from 3 to 7, one of 10, one of 12, one of 15, one of 18, and one of 22.

Poison.—Alcock and Rogers, experimenting on mice with the saliva of the whipsnake, sum up their results in the following remarks: "No one who has experimented with minimal lethal doses of cobra venom can fail to be struck with the close resemblance of the symptoms caused by it,

with those recorded in the experiments with the parotid secretion of *Dryophis*, and its opisthoglyphous allies."

In the human subject symptoms of poisoning are not usual, however, a sampwallah in Bangalore, when attempting to capture one, was bitten on the left hand about noon one day. I saw him at 4 P.M., and by that time the hand and forearm were greatly swollen, and he said felt numb. He experienced no constitutional symptoms, and the swelling completely subsided in two days.

In confirmation of this observation I note that Mr. Drieberg (Spol. Zeylanica, Vol. X., p. 177) says : "Mr. John Still when with me was bitten on the finger by an 'eye snake' (*S. gulla*), and was laid up with the wound for three days."

Again, Abercromby (Snakes of Ceylon, p. 23) relates a similar case where his servant suffered from local pain and swelling for two days after being bitten by a large specimen.

Parasites.—(*a*) *Ectozoa:* I have never seen this species infested with either ticks or mites.

(*b*) *Entozoa:* Dobell has found two protozoa in the intestine of the whipsnake, viz., a *Trichomonas* and a *Trichomastix.*

(*c*) *Hæmatozoa:* Dobell found some Ceylon specimens of this snake harboured a hæmogregarine in their blood.

Lepidosis.—(*a*) *Typical—Rostral* : The rostro-nasal sutures are bowed and much longer than the rest. The epidermal appendage has usually a gutter on the top and two laterally. *Internasals:* The suture between them rather shorter than that between the præfrontal pair, and subequal to the internaso-præfrontals. *Præfrontals:* The suture between them more than twice the præfronto-frontals; touching the internasal, 2nd and 3rd supralabials, præocular, and frontal. *Frontal*: The fronto-supraocular sutures are five or more times the length of the fronto-parietals. *Supraoculars:* As long as the frontal, twice or more than twice as broad as the frontal along a line connecting the centres of the eyes. *Parietals:* About as long as the frontal. *Nasal:* Entire. *Loreal:* Absent. *Præocular:* Makes a long suture with the frontal. *Postoculars:* Two. *Temporals:* One, small, scale-like, half the length of the supraocular. *Supralabials:* Eight; the 1st touching the nasal; 1st and 2nd the

internasals ; 2nd and 3rd the præfrontal ; 4th and 5th the eye ; 7th the temporal ; the 4th divided into two or three parts. *Sublinguals :* Posterior rather longer than the anterior, touching the 4th and 5th infralabials. *Infralabials :* Five ; the 4th and 5th large ; 5th about as long as the posterior sublinguals, and projecting behind them, about twice the breadth of those shields, touching two scales behind. (Fig. 58.)

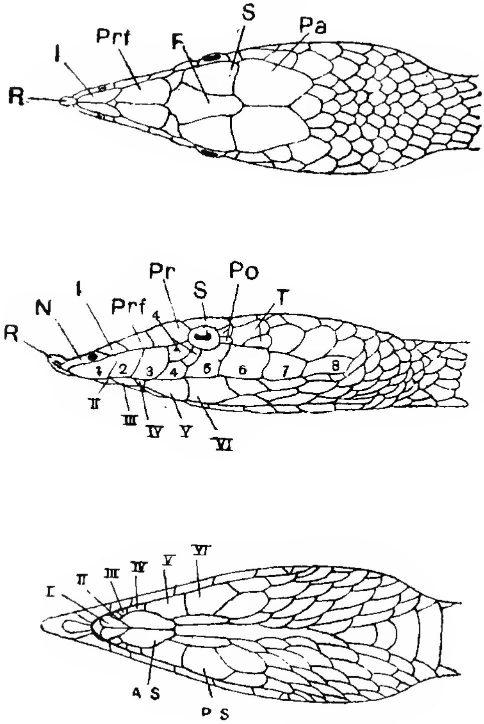

FIG. 58.—Dryophis mycterizans.
(Life size.)

Costals : Vertebrals enlarged, the breadth of the scales about three-fourths their length, and rather less than those of the ultimate row. Breadth of the oblique scales rather less than half their length. Ultimate row enlarged, the breadth

of its scales rather less than their length. A few scales above the anal region, with feeble beaded keels; scales otherwise smooth, and without apical pits or facets. In 15 rows to behind midbody, reducing to 13 or 11 two heads-lengths before the vent. In females they usually reduce to 13, and in males to 11. The reduction is effected at each step by the absorption of the fourth row from the ventrals. *Ventrals:* 168 to 206. *Anal:* Divided. *Subcaudals:* 127 to 174. (Fig. 59.)

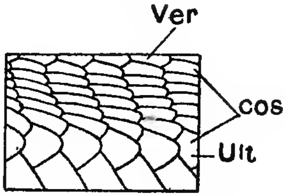

FIG. 59.—Dryophis mycterizans showing costals.

(*b*) *Anomalies—Loreals:* One or two minute scales some times occupy the place of these shields. *Ventrals:* The last shield is rarely divided like the anal.

Dentition.—*Maxillary:* Prænodal, 6 or 7; the first four or five coryphodont, the last two subequal and longer than the preceding. Præcranterian, 4 to 6; small, isodont. Cranterian, 2; long, subequal, obliquely set, and deeply grooved on their outer faces. *Palatine:* 7 to 10. *Pterygoid:* 17 to 28. *Mandibular:* Prænodal, 5 or 6; the first three or four coryphodont, the last two long and subequal. Postnodal, 14 to 16; small. (Fig. 60.)

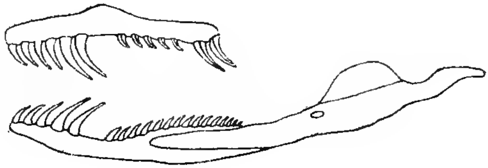

FIG. 60.—Jaws of Dryophis mycterizans.

Distribution.—(*a*) *General:* Ceylon, India, Assam, Burma, and Siam.

As far as I am aware only variety *typica* has been recorded from Ceylon. Variety *tephrogaster* is extremely rare in the Indian Peninsular, but as I obtained a specimen in Trichinopoly its occurrence in Ceylon is probable. Similarly, as I have had variety *fuscus* from the Anamallay Hills in India, it is to be expected in Ceylon.

(*b*) *Local:* It is quite a common snake in Ceylon, and a denizen of the low-country. In India I have acquired specimens in the hills up to about 6,000 feet.

DRYOPHIS PULVERULENTUS Dumeril and Bibron.

(Latin "pulverulentus" dusty, owing to the very fine speckling of the skin.)

The Brown Speckled Whipsnake.

Sinhalese: "henakandaya" (Willey).

Synonymy.—*Dryinus pulverulentus, Passerita mycterizans, P. fusca, P. purpurascens.*

History.—Described first by Dumeril and Bibron in 1854.

General Characters.—Grows to about 5½ feet. Head moderately depressed, broadest from behind the eyes to the neck. Snout long, narrowing to a point, and terminating in a projecting epidermal appendage; with a raised canthus. Loreal region markedly concave. Eye rather large, the iris powdered with gold. Nostril small, round, pierced in the back of the nasal. Neck markedly constricted. Body long, and very slender, markedly compressed in life, round after death, attenuating to the neck, and posteriorly. Belly rounded. Tail cylindrical, longer than in any other Asiatic snake, being more than one-third the total length.

Identification.—The lepidosis agrees very closely with that of *D. mycterizans*. Most easily distinguished from this species by the fact that the epidermal appendage is covered with small scales. The colour is brown, beautifully powdered with hues of a darker tone, and there is no lateral light line on the ventrals.

Habits.—Very little known. As far as I know haunts bushes and low scrub rather than trees. Abercromby says it is nocturnal in habit, but I think this calls for confirmation.

Food.—I found the tail of a skink, probably one of genus *Mabuia*, in the stomach of one specimen.

Breeding.—I found five sacs in one example containing embryos of such a size as to leave no doubt that it is viviparous.

Poison.—No information is to hand of any casualty.

Growth.—(*a*) *The Young:* I have seen a small example, apparently recently born, that measured 660 mm. (14 inches).

(*b*) *Maximum Length:* The largest I have seen was 1,587 mm. (5 feet 2½ inches), the tail 653 mm. (2 feet 1¾ inches). Boulenger mentions one 1,730 mm. (5 feet 6½ inches).

Lepidosis.—(*a*) *Typical:* This accords so closely with that of *D. mycterizans* as not to call for a detailed description. *Ventrals:* 180 to 212. *Subcaudals:* 146 to 207.

(*b*) *Anomalies—Loreals:* Rarely present. I have seen one with a small anterior and a posterior one. *Supralabials:* Sometimes nine or ten, the 4th and 5th divided, and 4th, 5th, and 6th touching the eye; or 5th and 6th divided, and 5th, 6th, and 7th touching the eye; or 4th, 5th, and 6th divided, and 5th, 6th, and 7th touching the eye.

Dentition.—From two skulls in my collection, one from Ceylon and one from the Nilgiri Hills. *Maxilla*: Prænodal, 7; the first five coryphodont, the last two larger than the preceding and subequal. Præcranterian, 5 or 6; small, isodont. Cranterian, 2; enlarged, subequal, obliquely-set, grooved on their outer faces. *Palatine:* 9. *Pterygoid:* 19 to 22. *Mandibular:* Prænodal, 5; the first three coryphodont, the last two enlarged and subequal. Postnodal, 13 to 16; isodont.

Distribution.—(*a*) *General:* South India and Ceylon.

(*b*) *Local:* It has been recorded by Haly from Ratnapura and Wadduwa. One in the Colombo Museum of the Swayne collection is from Horana, and another is from Weuda, Kurunegala District. I have seen specimens from Galle, Veyangoda, Kandy, and Kalupahana, Haldummulla District (about 3,000 feet). Mr. Green obtained one at Peradeniya. Mr. Drummond-Hay tells me he got three from Rasagalla District and many at Punagalla, Yatiyantota District, below about 1,000 feet, but not up-country. It appears to be a low-country species ascending the hills to about 3,000 feet.

Genus CHRYSOPELEA.

(Greek "chrusos" gold, and "peleios" black.)

General Characters (for Indian species).—As detailed under the species.

Identification.—The keeled ventrals taken with the vertebrals not being enlarged will declare the genus.

Habits.—Arboreal. Diurnal. Very active. Fierce when provoked.

Food.—Mainly lacertine.

Breeding.—Little known. Probably oviparous.

Poison.—Feebly poisonous. No ill effects have ever been reported as a result of its bite.

Lepidosis.—*Rostral :* Touches six shields. *Internasals :* A pair. *Præfrontals :* A pair. *Frontal :* Touches eight shields usually. *Nasals :* Divided. *Loreal :* One. *Præoculars :* One, usually touching the frontal. *Postoculars :* Two. *Temporals :* Two, rather small. *Supralabials :* Nine or ten. *Sublinguals :* Two pairs, the posterior rather longer. *Infralabials :* Six.

Costals : Longer than broad, feebly keeled in some median rows in the posterior part of the body, with paired apical pits. *Vertebrals :* Not enlarged, rectiform ; breadth of scales about three-fourths their length, and about three-fourths that of the ultimate row. Lateral rows subequal, feebly oblique. Ultimate row enlarged, the breadth of its scales subequal to their length. In 17 rows to behind midbody, reducing to 13 two heads-lengths before the vent. *Ventrals :* Strongly keeled laterally. *Supracaudals :* In even rows. *Anal :* Divided. *Subcaudals :* Divided ; strongly keeled laterally.

Dentition.—*Maxillary :* Syncranterian, anododont, feebly coryphodont ; teeth feebly grooved basally on their outer faces, the last three or four deeply grooved from base to apex. *Palatine :* Anododont, scaphiodont. *Pterygoid :* Anododont, scaphiodont. *Mandibular :* Anododont, feebly kumatodont.

Distribution.—South-Eastern Asia.

There are three species, one of which occurs in Ceylon, viz., *ornata*.

CHRYSOPELEA ORNATA Shaw.

(Latin " ornata " adorned.)

The Gold and Black Tree Snake.

Sinhalese : " pol-mal-karawala " (Ferguson) ; " mal-karawala " (Willey).

Synonymy.—*Coluber ornatus, C. ibibiboca, Tyria ornata, Dendrophis ornata, D. paradisii, Leptophis ornatus, Chrysopelea paradisi, C. rubescens.*

History.—Seba in 1734 was the first to refer to the species, which he figured in Plate XCIV., Fig. 7, of his first volume, again in Plate VII., Fig. 1, Plate LVI., Fig. 1, and Plate LXI., Fig. 2, of his second volume. Russell mentioned and figured it in his second volume, Plate II., in 1801.

General Characters (from Indian species).—Grows to 4½ feet. Head pear-shaped, strongly depressed. Snout moderate in length, hardly declivous, without canthus, broadly rounded terminally. Eye large, with round pupil. Nostril moderately large, placed in the upper two-thirds of the suture between the nasals. Neck distinctly constricted. Body rather long, somewhat compressed. Belly with sharp lateral keels. Tail moderate, about one-fourth the total length.

Identification.—The most striking feature in the lepidosis is the lateral, sharply keeled condition of the ventral shields. This is only seen in the genera *Dendrophis*, *Dendrelaphis*, and *Chrsopelea.* From the two other genera it is distinguished by the vertebral row of scales not being enlarged.

The characters mentioned under the genus will distinguish this from all other Ceylon snakes. Further, this is the only Ceylon species with the costals in 17 rows, two heads-lengths behind the head, 17 at midbody, and 13 two heads-lengths before the vent. Another character peculiar to the species is that the last ventral shield is always divided like the anal.

Colouration.—There are many colour varieties, but as far as I am aware only two occur in Ceylon.

*Variety E.** : Greenish-yellow or pale-green above, each scale edged, and mesially streaked with black. The black heavier in parts so as to form more or less distinct cross-bars. A series of large coral-red or orange spots along the spine, separated by two cross-bars. Ventrally yellow, with a small black spot laterally on each shield.

*Variety F.** :—Pale olive above, with regular black cross-bars tapering laterally; some of the black scales with yellow shafts. Whitish-olive beneath, with a lateral black spot on each ventral. The head in both is barred with black and yellow.

Habits.—(*a*) *Haunts:* Very opposite opinions prevail as to its haunts. Cantor says it is seldom seen in trees, but more frequently on the ground in the grass. Stoliczka supports this observation. and says though he caught several specimens in the grass or between low bushes, he but once saw one actually on a bush. Flower, on the other hand, says his experiences are very different in this as in other matters from those related by Cantor, and he agrees with Gunther's suggestion that the reason it is not more often seen in trees is because it makes a too rapid retreat.

I am able to support both parties, for I have seen it high in a tree on a naked limb, and on several occasions on bushes, or on the trellis work about tennis courts and verandahs. I never met it on the ground myself, but many of the specimens brought me were reported on the ground. I have not the least doubt that the species is essentially arboreal in habit, but this does not prevent it making frequent excursions to the ground, either in search of a fresh feeding area, or in the pursuit of the incautious quarry, which its keen vision has detected from its exalted station amid the branches overhead.

It is only natural that it should be more frequently encountered on the ground, because the eyes of the pedestrian are directed below the level of his head, even at his feet. Men other than birds-nesters, fern and orchid hunters, and such like do not gaze much aloft, and the snake reclining along

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* Cf Boulenger. Catalogue Snakes British Museum. Vol. III., 1896, page 196.

a branch, or on the top of a trellis work even about one's own height, will frequently escape detection, though but a few feet or even inches away.

The very fact that Cantor and Stoliczka, in unison with other observers, mention that geckoes are the principal food, seems to me to refute their suggestion that *Chrysopelea* is terrestrial in habit, for geckoes are eminently arboreal. It is to be noted also that all the food partaken of, other than geckoes, is of a nature to be obtained usually by climbing. Cantor's inclusion of frogs in their dietary does not vitiate this remark, for though he does not say so, the species taken may have been arboreal forms.

Chrysopelea is not infrequently found about, and actually inside, habitations. Flower mentions this, and Evans and I had similar experiences in Burma. I well remember in Colombo, too, one that had taken up its quarters in an old packing case, which was full of straw and other packing material. A cooly was ordered to clear this out, and stepped into the box to carry out his orders. His exit reminded one of an incautious bather who has stepped into over-hot water. The alacrity of movement so foreign to the cooly's nature was explained by the subsequent discovery of a snake of this species. Dr. Malcolm-Smith says it is "very common in Bangkok (Siam), and owing to its partiality for living in houses, is the snake which is brought more into contact with the residents of the town than any other kind."

(*b*) *Disposition:* Very divergent views, again, have been expressed on this point. Cantor remarks on the gentleness of the species, whilst Flower, on the other hand, says: "*Chrysopelea ornata* is the fiercest snake I have met. Under circumstances when most snakes, harmless and poisonous alike, would try to glide away quietly, this one will turn to attack the person who disturbs it, and will attempt to resist capture to the uttermost, striking, and biting ferociously . . . . Individuals I have at various times tried to keep in captivity showed no signs of becoming tamer, and would always bite my hand when I put it in the vivarium, and being also an annoyance to the other inmates of the cage, I have only kept them for a few days at a time."

I must say I can abundantly confirm Flower's experiences. There is no doubt that this snake is decidedly plucky, and on occasions fierce, but I would not suggest that all are equally vicious. I think that snakes, like other creatures, exhibit individual character.

I well remember my servant in Rangoon trying to effect the capture of a large specimen in a hedge adjoining my compound. I arrived on the scene when the excitement was at its height, and discovered that all the menial establishment, amounting to ten or more, had been pressed into service. The snake had fought most courageously to elude capture, and struck at anyone who ventured to attempt to grasp it. My boy, confident of master's solatium in the form of a rupee, if the creature was captured alive, had been struck at and bitten, and I hardly knew which to admire most, the servant's determination and courage, or the snake's vigourous endeavours to retain its liberty.

Flower mentions one in a fit of rage biting itself with such vigour that its teeth were fixed into the side of its body, and I can remember recapturing one which had escaped from my vivarium and had taken refuge between some boards in my house. When extricated after some difficulty, and with the employment of some force, it struck at and buried its teeth in its own body.

The fact that this snake will not only engage, but sometimes overcome, so formidable an antagonist as the tuctoo (*Gecko verticillatus*), is in itself sufficient proof of its courage. This remarkable Burmese lizard grows to over a foot, and is renowned for its truculence and the strength of its jaws. Flower says that the tuctoo may give battle to the gold and black tree snake for some hours before being finally swallowed. Captain Lloyd, I.M.S., sent me the following account of an encounter he witnessed between a *Chrysopelea* and a tuctoo on Sandoway Island: "The snake was on the ground in combat with a tuctoo, and faring badly as the gecko had it fast held in its jaws some inches behind the head—the marks of the jaws were plainly visible. Finding it difficult to catch either whilst on board, I shook them off into the sea, but in

spite of this they renewed the combat in the water." Dr. Malcolm-Smith says he knows of several cases where this snake engaged a tuctoo, and adds "it is not always that the snake comes out of these combats unharmed, and considering the tremendous bite which this lizard can give, it is not surprising. In one encounter, at least that I know of, the gecko had got a firm hold immediately behind the head of its opponent, although the snake ultimately proved the victor, it was so badly damaged as to be only just able to crawl away, leaving its victim uneaten."

(*c*) *Nocturnal or Diurnal :* It is completely diurnal in habit, and may be met with sometimes on the hottest days, apparently sunning itself, but more probably on the lookout for food.

(*d*) *Progression :* The striking beauty of this snake, whether seen reclining or moving in its native haunt, could hardly fail to arouse the keenest admiration in the breast of the most unappreciative and phlegmatic disposition.

I watched with admiration once the adroit and stealthy manner in which one in captivity in the Colombo Museum balanced itself and moved along my walking stick, though this was more slender than the snake itself.

Dillwyn describes this snake clinging to the trunk of a tree, head downwards, in a very extraordinary manner, and I have seen it in almost exactly similar circumstances. My specimen was stationary, clinging (one could not say reclining) head downwards, about 30 feet from the ground, to a large bare trunk, which rose almost perpendicularly. I marvelled at the tenacity of its grip in such a situation. It had thrown its body into a very wide S across the limb, and it strikes me now very forcibly, after reading Flower's and Shelford's observations, that it may have been "gathering itself" for a leap. The enraptured observer will be even more captivated with the grace and agility attending its movements from branch to branch, and the consummate ease with which it will scale a perpendicular trunk. Its flash-like disappearance aloft without apparent effort, must be witnessed to be fully appreciated.

I very much doubt whether any snake moving along the flat displays greater speed than this species in its arboreal environment.

But its marvellous attainments do not end here, for this snake is endowed with the capability to spring, or " fly " as some prefer to call this jactatory effort. Here, one is forcibly reminded of the eulogistic terms in which the late Professor Owen summed up the athletic performances of these limbless creatures.

He says: " They can outclimb the monkey, outswim the fish, outleap the jerboa, and suddenly loosing the coils of their crouching spiral, they can spring into the air, and seize the bird upon the wing."

One has only to be acquainted with *Chrysopelea* to realize that Owen's words convey no fulsome flattery.

That it actually can spring is vouched for by more than one reliable observer. Flower* in 1899 reported having seen " a small one, about 2½ feet long, take a flying leap from an upstairs window downward and outward on to a branch of a tree, and then crawl away among the foliage. The distance it had jumped was measured, and found to be nearly 8 feet."

Curiously enough in the very month (May) and year (1899), when this record of Flower's was published, Mahon Daly wrote from Siam reporting his having witnessed a similar feat. His letter appeared in Vol. XII., p. 589, of the Bombay Natural History Journal, and though he could not identify the snake, he said that he and his Kareen interpreter saw a snake, " about 2½ feet long sail from a very high tree on one side of the road to a lower one the opposite side."

In confirmation of these very extraordinary acrobatic feats, which I have no doubt many might be inclined to disbelieve, is the report made by Shelford of similar performances.† This observer relates that three native witnesses in Sarawak made a similar statement on three different occasions independently of one another, and at considerable intervals of time.

* Proc. Zool. Soc., Lond., 1899, p. 684.
† Proc. Zool. Soc., Lond., 1906, p. 227.

This was to the effect in each case that the snake had been seen to " fly " from some height to the ground beneath. In all cases the snake was reported to have kept its body rigid during this feat, and to have met the ground at an oblique angle. In one case the snake proved to be *Chrysopelea ornata*, in the second instance a snake of the same genus, viz., *C. chrysochlora*, and in the third *Dendrophis pictus*.

Shelford calls attention to the fact that all these snakes are alike in the peculiar keeled condition of their belly shields, and he made experiments to ascertain the truth of these reports. He says : " A specimen of *Chrysopelea ornata* was taken to a height of 15 to 20 feet, and allowed to fall several times ; after one or two false starts the snake was felt to glide from the experimenter's hands, straightening itself out, and hollowing in the ventral surface as it moved, and it fell not in a direct line to the ground, but at an angle, the body being kept rigid the whole time . . . If the snake was thrown up into the air, it seemed unable to straighten itself out ; it had to be launched, so to speak, from the hands in order to induce it to assume the rigid position."

He implies, therefore, that these "flights " are not accidental falls, but deliberate voluntary efforts, and suggests that the hollowing of the belly between the two ventral ridges may act mechanically after the manner of a parachute, impeding the action of gravity, and buoying up the creature so as to reduce the momentum with which it would strike the ground. He illustrates this point by comparing the fall of a piece of bamboo bisected longitudinally, with the concave face downwards, and that of a piece of bamboo in its cylindrical form. In the former case the descent is retarded. I prefer the use of the term " springing " to that of " flying " in describing these feats. Its only rivals in acrobatic and scansorial achievements are the tree snakes of the genera *Dendrophis* and *Dryophis*.

Food.—*Chrysopelea*, whilst showing a decided partiality towards lizards of the family *Geckonidæ*, accepts with avidity many other creatures that chance has to offer.

Members of the genus *Hemidactylus* are frequently found to have furnished the meal, obviously from the relative abundance

of the species in this genus, and the numerical strength in individuals of many of the species which frequent trees. Many other lizards, however, fall victims to its voracity. Cantor mentions frogs as well, but I have never known one taken, have known them refused in captivity, where lizards were accepted, and Mr. Millard tells me also he found frogs were not acceptable. Among other lizards Cantor found *Ptychozoon homalocephalum* taken once; and Evans, one of the flying lizards (*Draco tænipterus*). I have known *Calotes versicolor* taken; and Flower, the giant gecko or tuctoo of Burma (*Gecko verticillatus*). Evans and I reported one that had eaten a bat (*Taphozous longimanus*), and Evans has since recorded two instances where bats were devoured. Mr. Millard tells me that in captivity it "feeds freely on bloodsuckers, sparrows, geckoes, and mice, but never eats frogs." He also says it kills by crushing in its folds.

It is interesting to note that Richards mentions one of his boys having a pet *Chrysopelea ornata*, which he fed with milk out of a saucer. He held the snake near the head, and put the saucer to it, when it readily drank the milk, and in comparatively large quantities.

Dr. Malcolm-Smith records it eating another snake (*Dendrophis pictus*) on one occasion.

Breeding.—(*a*) *The Sexes:* There is no special difference in the lepidosis of the sexes. My notes throw no light on to the growth of the sexes.

(*b*) *Method of Reproduction* Not known.

(*c*) *Season:* Evans and I in Burma had egg-bound specimens in May and June, and subsequently Evans had another example in a similar state in June. A brood is recorded in the same month at Rangoon by Evans.

(*d*) *Period of Gestation:* Not known.

(*e*) *The Brood:* The four breeding events known to me show that the brood varies from 6 to 11.

Growth.—(*a*) *The Young:* A Ceylon specimen which appeared to have been recently born or hatched measured 240 mm. (9½ inches). Evans, however, speaks of a brood he discovered at Rangoon, the young of which varied from 114 to 152 mm. (4½ to 6 inches). He does not say whether he extracted these from eggs or found them inside the mother.

(*b*) *Early Life:* My records are too meagre to enable me to follow the growth of succeeding broods.

(*c*) *Maturity:* My smallest gravid example was 1,093 mm. (3 feet 7 inches).

(*d*) *Maximum Length*. Specimens over 4 feet are unusual. The largest I know of was acquired by Evans and me in Burma, and taped 1,360 mm. (4 feet 5½ inches). Malcolm-Smith says it grows to 1,400 mm. (4 feet 7 inches).

Parasites.—*Hæmatozoa:* Miss Robertson has discovered *hæmogregarine* parasites inhabiting the erythrocytes of this species, and similar to those found in the common ratsnake, named by Laveran *Hæmogregarina zamenis.*

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures longer than the rostro-internasals and about twice the rostro-labials. *Internasals:* The suture between them two-thirds to three-fourths that between the præfrontals, two-thirds to three-fourths the internaso-præfrontals. *Præfrontals:* The sutures between them subequal to or rather longer than the præfronto-frontals; touching the internasal, postnasal, loreal, præocular, and sometimes supraocular. *Frontal:* The fronto-supraocular sutures three times the length of the fronto-parietals. *Supraoculars:* As long as the frontal, and about the same breadth as the frontal along a line connecting the centres of the eyes. *Nasals:* Divided. *Loreal:* Longer than deep, about two-thirds the length of the nasals. *Præocular:* Touching or almost touching the frontal. *Postoculars:* Upper rather the larger. *Temporals:* The lower little more than half the length of the supraocular. *Supralabials:* Nine; the 1st and 2nd touching the nasals; the 4th, 5th, and 6th, or 5th and 6th only touching the eye; and the 6th, 7th, and 8th, or 7th and 8th only touching the lower

temporal. *Sublinguals :* Posterior longer than the anterior; touching the 5th and 6th infralabials. *Infralabials :* Six; the sixth much shorter than the posterior sublinguals, about twice as broad as those shields, touching two scales behind.

Costals : In 17 rows two heads-lengths behind the head, 17 in midbody, reducing to 13 two heads-lengths before the vent. The reduction of rows from 17 to 15 is due to the absorption of the fourth row from the ventrals, and from 15 to 13 to the absorption of the sixth row. The steps of reduction occur close together, and the absorption may be in reverse order. *Ventrals :* 200 to 238; the last is invariably divided. *Anal :* Divided. *Subcaudals :* 97 to 144. (Fig. 61.)

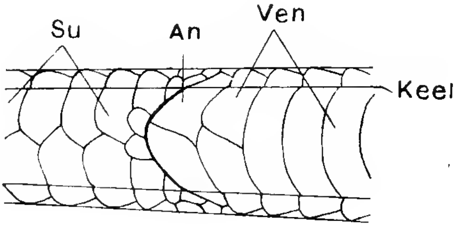

FIG. 61.—Anal region of Chrysopelea ornata.

(*b*) *Anomalies—Temporal :* Rarely one only. *Supralabials :* Sometimes ten. *Ventrals :* The penultimate is rarely divided like the ultimate. *Anal :* Very rarely entire.

Dentition.—From four skulls in my collection. *Maxillary :* 20 to 22. *Palatine :* 9 to 11. *Pterygoid :* 21 to 27. *Mandibular :* 19 to 23.

Distribution.—(*a*) *General:* Ceylon. Hills on the western side of Peninsular India. The Eastern Himalayas, Eastern Bengal, Assam, Burma, Indo-China to South China. Malay Peninsula, and the Malay Archipelago from Sumatra to the Philippines.

(*b*) *Local:* In Ceylon it frequents the low-country, but cannot be called a common snake. Mr. Green in a letter tells me it does not appear to ascend the hills above about 1,500 feet. Mr. Drummond-Hay tells me he killed one at Weyvelwatta, one in the Kanthalai resthouse, two at Punagalla (below 1,000 feet), and one near Balangoda, but has seen no others.

Sub-family 6 **Elachistodontinæ.**

(Greek "elachistos" small, "odous" tooth.)

There is only one representative of a single genus, viz., *Elachistodon westermanni*, peculiar to Western Bengal.

Series C **PROTEROGLYPHA.**

Sub-family 7 **Hydrophiinæ.**

(Named from the type Genus *Hydrophis.*)

As a result of many years' special study of the *Hydrophiinæ,* I find I can only recognize as distinct with certainty those species from the Indian seas from the Persian Gulf to Tenasserim that are enumerated and dealt with hereafter. Many others have been described by various authors. Some of these are known from a solitary specimen, and all rest upon characters that are either known to be inconstant in most of the seasnakes, or depart but slightly from normal specimens of the species recognized herein by me.

My views have not been hastily arrived at, but are the result of many years' special study of marine forms. Among various large collections, I have examined all the seasnakes in the British Museum, not once, but many of them repeatedly, and side by side with the allied forms from which they are supposed to differ. In the Indian Museum too I have examined the specimens most critically half a dozen and more times side by side.

My most recent work has been largely devoted to a study of skulls and dentition, and I think the recognition of genera and species should depend, if not entirely, almost entirely upon these characters. I have drawn up a synopsis of these characters which differentiate the genera and species I recognize.

In my "Monograph of the Seasnakes," published by the Asiatic Society of Bengal in 1909, I pointed out that the grounds upon which Mr. Boulenger based his genera *Hydrophis* and *Distira* were mistaken, and he has acknowledged this in his most recent work on the Reptilia of the Malay Peninsula, published in 1912, where all the species are now placed in a single genus under the former title. Some other mistakes pointed out by me have been therein acknowledged and rectified.

Nomenclature.—It is difficult to find appropriate English names for the species. I have accordingly associated with each the name of one of our best known herpetologists, as a fitting memorial to his work.

General Characters (for Indian species).—With the exception of the members of the genus *Platurus* (which are of fairly even calibre and cylindrical throughout), the bodies of seasnakes are cylindrical, and more or less attenuated in about the anterior two-fifths, compressed and heavy in about the posterior three-fifths. In some species the head and forebody are remarkably slender, even amounting to one-quarter the depth at the greatest girth posteriorly. Another peculiarity too (excepting again *Platurus*) is that the dorsal length over the compressed part of the body is longer than the ventral length, so that a seasnake is curved like a prawn.

One notices this in trying to measure a specimen. All goes well till the thickened posterior part is reached, when one has to constantly shift the tape to measure round the curve. The curvature in some species is so pronounced that when the dead snake is laid on its side the body almost completes a circle! This curious conformation serves the purpose of giving the snake prehensile powers, so that it can wreath the body securely round seaweed and other objects, and so anchor itself. It seems to me probable also, that the body is used to hold its victims until the poison injected has had time to work, for the head is so small in some species that it is difficult to imagine the jaws powerful enough in themselves to hold a struggling victim of anguine form. The tail is highly compressed in all hydrophids, and forms a fin-like appendage of great service in swimming. The eye is small. It is placed laterally, has a round pupil, and, except in the case of *Platurus*, the iris is coloured dull greenish. The nostril (except in *Platurus*, where it is lateral) is large, superior, valvular, and situated in the postero-external quadrant of a large nasal shield.

Identificaion.—The fin-like tail at once proclaims a sea-snake, and distinguishes it from all terrestrial and fresh water forms.

Colouration.—The colouration and the adornment is remarkably similar in nearly all the forms. The dorsum is usually a dirty olivaceous or dull bluish, these hues merging to whitish or yellowish of various shades ventrally. The young are usually very conspicuously banded with dark bluish, greenish-black, or black. The bands are well defined, but tend as age advances to lose definition. Further, it frequently happens that the bands become effaced ventrally, and so converted into dorsal bars. The head in the young is either uniform black or black with a horse-shoe mark on the crown. As age advances the black fades, the horse-shoe is resolved into an indefinite mottling, and ultimately the head becomes a pale olivaceous or pale dirty yellowish. The fact that the colouration is so much alike in all the hydrophids denotes some special purpose. It is probable

that it is protective, and that like the stripes of the tiger and zebra the bands break up the contour of the snake in its submarine haunts and assist in concealing it, so that it is not observed by its prey until well within striking distance.

Habits.—(*a*) *Haunts:* All the species are marine. They mostly frequent the close vicinity of the coasts, and frequently find their way up tidal rivers for fifty or even a hundred miles. They are often observed in and about the rocks that fringe the shore. On the other hand, they are frequently observed in the sea as many as a hundred or more miles from any coast.

(*b*) *Disposition:* They exhibit an extraordinarily peaceful nature, and it is most unusual for one to attempt to bite. This is borne out by the fact that although the seas literally swarm with them, bathers and fisher folk are practically never bitten. There are scarcely any records of casualties even among the fishermen, who haul them in by the dozen every day in their nets. The snakes so caught are handled fearlessly by those drawing in the nets, who throw them back into the sea. Dr. Annandale remarks, on the authority of fishermen, that when a casualty does occur, it is usually in the surf. The snakes that come too close to the shore in the monsoon are sometimes rolled over and over impotently by successive waves, and as the result of the battering they receive, they are apt to wreath themselves round any support, and plunge their teeth into it.

(*c*) *Nocturnal or Diurnal:* They appear to be completely diurnal.

(*d*) *Progression:* They swim with graee and ease, and can move expeditiously in the water when danger urges them to do so. Sometimes they may be seen swimming with the head and some inches of the forebody pushed up vertically, as though to inspect their surroundings. When hustled they frequently plunge deeply and disappear. On land the compressed and heavy conformation of their bodies makes progression almost impossible, and they lie over helplessly on their sides. Species of the genus *Platurus*, however, are not so handicapped, and can progress fairly well on land.

(*f*) *Hissing :* Dr. Annandale says they do not hiss, but utter a low gurgling note.

(*g*) *Sloughing :* Desquamation occurs at intervals as in the case of land snakes, but the slough is cast in fragments.

Food.—As far as is known they are entirely piscivorous. The fishes usually selected are those with slender elongate bodies. Dr. Annandale mentions Silurids (Cat fishes), and Gunther the Silurid fish, *Apogon*. I have extracted fish from some, which Dr. Henderson identified as Muræenids (eels). An element of doubt lay between the species *Ophichthys boro.* or *O. orientalis.* Many of these fish have very strong spines as noted by Gunther, and Dr. Annandale says that the spines are frequently discharged through the tissues. They penetrate the walls of the stomachs, and work their way through the tissues between the ribs, and are finally expelled, without causing any serious mischief to the snake. This is a curious adaptation, for the danger of such spines wounding the intestine must be great.

Breeding.—(*a*) *The Sexes :* There is nothing very special to remark. Both appear to grow to similar lengths. In the female the body is deeper posteriorly, and especially so when gravid. In the males a bilateral swelling along the base of the tail corresponds to the clasper tubes. In some I have found the male genitalia bifid, in others not. The genitalia, as in land snakes, are extruded in intra-maternal life until shortly before birth, but they are ensheathed some appreciable time before birth. The tubercles and keels on the costals and ventrals are usually more pronounced in males, and grow stronger with advancing years.*

(*b*) *Method of Reproduction :* All those whose breeding habits are known are viviparous.

(*c*) *Season :* The breeding season probably extends over several months of the year, but available records are too limited to elucidate this point.

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* In many spirit specimens the character of the keels and tubercles on the scales are difficult to discern, but I have satisfied myself that these are distinct and constant in both sexes from the earliest age, even, in fact, before birth.

(*d*) *Period of Gestation :* This is not known, and the difficulties in investigating the point are great, as seasnakes do not thrive well for long in captivity, even in capacious tanks.

(*e*) *The Brood :* The various species seem to vary much in their fecundity. Some give birth to one or two at a time, and others up to as many as sixteen.

Growth.—(*a*) *The Young :* These vary in their measurements with the species. In some the young are retained until they attain to a length half that of the mother.

(*b*) *Early Life :* From a small material at my disposal, I am able to say that in some cases the young double their length in the first year of life.

(*c*) *Maturity :* In some species I have observed maturity is attained in a remarkably short time, even as little as a year ; in other species it appears to be considerably longer, two or three years. Without wishing to be at all emphatic it appears from my notes that the species that are least prolific show the most precocious attainment to sexual maturity.

(*d*) *Maximum Length :* The largest measurement I am aware of is 2,745 mm. (9 feet). This was for a *spiralis* killed by Mr. Stone at Penang.

Poison.—Beyond the fact that all are poisonous, and apparently very fatal, little is known. I can only find one record in which the snake causing a bite in the human subject was killed, and identified. This is mentioned under *Hydrus platurus.* The poison of two species only, viz., *Enhydrina valakadyen* and *Enhydris curtus*, has been worked with in the laboratory, and in the case of the former the venom is shown to be much more potent than cobra venom. Russell caused a few other species to bite fowls, all of which succumbed in a few minutes, so that the venom of all appears to be extremely virulent. It is rather a reflection on Indian Zoologists, that for a glimmering appreciation of the toxicity of some of the venoms, one should have to hark back one hundred and twenty years to Russell's experiments for information !

Foes.—Gunther mentions among the chief foes the sea eagles of the Genus *Haliætus* and sharks. I have never witnessed a seasnake borne off by any raptorial bird, but

there is little doubt that the sea eagles take considerable toll of their ranks. It is more than likely too that the brahminy Kite *Haliastur indus* is among those that prey on them. When hydrophids travel up tidal rivers, as they do in considerable numbers, it is probable that many fall a prey to other predatory birds and animals. A writer to "The Field" from South Africa about October, 1919, mentioned crocodiles as preying upon freshwater snakes within his knowledge, and it is possible that seasnakes are victimized by these creatures. I have never heard of any instance of ophiophagy among seasnakes, but the fact that it is long and slender fish that form their dietary makes it possible that small seasnakes may be preyed upon by the larger members of their fraternity.

Epiphytes and Epizoa: Hydrophids are infested by many lowly-organized plants and animals that attach themselves to their scales and hamper their movements. Sometimes the growth of the former is such as to make the whole snake quite shaggy in appearance. These are not parasitic, as they do not live on their host's tissues or blood. Many, indeed, are as frequently found attached to floating timber, piers, cables, &c. For a list of these I am indebted to Dr. Annandale, who has specially interested himself in this study.

(*a*) *Hydroids* on species of *Hydrophis.*

Bimeria fluminalis (Annandale).
Campanularia serrulata (Bale).

(*b*) *Polyzoa* on *Enhydrina valakadyen.*

Alcyonidium mytili (Dalzell) on species of *Enhydris.*
Triticella pedicellata (Alder).
Membranipora hippopus (Levinson).

(*c*) *Barnacles* on *Hydrus platurus.*

Lepas anserifera (Linné).
* *Lepas tenuivalvata* (Annandale).
Conchoderma virgatum var *hunteri* (Owen).
Dichelaspis warwicki (Gray).

* Has only been found attached to seasnakes.

* *Platylepas sp.* (?) (Darwin) on *Enhydrina valakadyen.*
* *Platylepas ophilus* (Lankester) on species of *Hydrophis.*
* *Platylepas krugeri* (Pilsbury).
* *Dichelasphis grayi* (Darwin).

Lepidosis.—As already remarked the shielding of the head and scaling of the bodies of hydrophids are subject to a variation which is far in excess of what one sees in the most variable land snakes. Gunther in 1864 wrote that herpetologists who preceded him, with the single exception of Gray, had erred in supposing the numbers of species of seasnakes to be far fewer than they in reality are. If that remark was true fifty years ago, Gunther and succeeding herpetologists have amply redeemed the aspersions cast upon their forefathers by erring in a contrary direction. Many an individual exhibiting a slight deviation from a previously well-known species has been acclaimed as a new species, even by our best herpetologists. When one sees the large range of costal rows round the neck and body, of the ventrals between the neck and vent, and of the great variation in the head shielding of so distinctive a species as *Enhydrina valakadyen*, one should be prepared to expect a similar degree of variation, in some other species of hydrophids with less distinctive characters.

Dentition.—*Maxillary :* Prænodal. Two canaliculate fangs are placed side by side anteriorly, each with a scar on its anterior face. Postnodal. From 1 in *Platurus* to 17 in *Polyodontognathus cærulescens* ; isodont, or feebly scaphiodont. With shallow grooves on their antero-external faces. *Palatine :* 5 to 10 ; anododont, isodont. A short edentulous space posteriorly in some. *Pterygoid :* 7 to 27 ; anododont, scaphiodont. The posterior half to third edentulous. *Mandibular :* 9 to 26 ; anododont, scaphiodont ; grooved on their antero-external faces.

Distribution.—Indian and Pacific Oceans. Many appear to have a very local distribution, others, notably *Hydrus platurus*, a very extensive one.

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* Have only been found attached to seasnakes.

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Genus MICROCEPHALOPHIS.

(Greek " micros " small, " cephale " the head, and " ophis " snake.)

General Characters.—Length small to moderate. Neck and forebody very slender, the diameter anteriorly one-third to one-fourth that of the extreme depth posteriorly. Commissure of the mouth shaped like an italic *f*.

Cranial Osteological Characters.—*Nasals :* Sutured to frontal and præfrontal ; longer than the frontal. *Præfrontals :* Meet the parietal, but not the postfrontals. *Frontal :* As broad as long ; meeting postfrontals at the rim of the orbit. *Parietals :* With no keel inferiorly. *Quadrate :* Vertical ; the extreme length superiorly equal to its depth. This bone reminds one of the iliac portion of the human *os innominatum* (haunch bone), and is the same in all the five most slender-necked species (*gracilis*, *cantoris*, *obscurus*, *diadema*, and *fasciata*). *Maxilla :* Extends beyond the palatine anteriorly and posteriorly.

Dentition.—*Maxilla :* Postnodal, 5 to 6 ; isodont. *Palatine :* 7 to 8 ; anododont, isodont ; no edentulous space posteriorly. *Pterygoid :* 9 to 13 ; anododont, isodont ; posterior half edentulous. *Mandibular :* 11 to 13 ; anododont, feebly scaphiodont.

There are only two species, viz., *gracilis* and *cantoris*.

Microcephalophis gracilis (Shaw).

(Latin " gracilis " graceful.)

John's Seasnake.

Tamil : " milagu kadiyan " * (pepper biter) (Henderson).

Synonymy.—*Hydrus gracilis*, *Anguis mamillaris*, *Liopala gracilis*, *Hydrophis guentheri*.

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* Dr. Henderson tells me this and other small-headed seasnakes are so called in Madras, on account of the small head, which is fancifully likened to a peppercorn (milagu).

History.—First depicted by Russell in Plate XIII. of his second volume (1801). Christened by Shaw in 1802.

General Characters.—A small snake growing to about 3 feet. Head very small, elongate, not depressed. Snout long, subconical, strongly declivous, obtusely rounded terminally, slightly produced downwards. Eye small. Nostril with no sutures radiating therefrom. Commissure of mouth shaped like an italic *f*. Neck not apparent. Body cylindrical, and slender in its anterior two-fifths, and about one-third to less than one-fourth the extreme depth posteriorly, compressed and heavy in the posterior three-fifths.

Identification.—Easily recognized by the figure-of-8 tubercles on the scales, 17 to 21 scale rows two heads-lengths behind the head, and ventrals numbering 217 to 290.

Colouration.—Dull olive-green dorsally, merging to pale-yellow or whitish ventrally. Body with from 41 to 61 black annuli, dilated vertebrally, and much confluent vertebrally and ventrally, especially on the slender part of the forebody, so that only oval whitish windows are left laterally. The annuli are well defined, black, and complete, or but slightly interrupted laterally in the young, but tend to lose definition as they grow older, grow less black and completely disappear ventrally in old adults, leaving dull, dark, greenish-black dorsal bars. The head is quite black in the young, but fades to a dull greenish-black with age.

Habits.—There is nothing special to remark.

Food.—I have always found muraenids preyed upon. Specimens submitted for indentification to Dr. Henderson were reported to be either *Ophichthys boro* (Ham. Buch.) or *O. orientalis* (McClelland). I have seen as many as three of these eels in one stomach, and one measured 8 inches in length.

Breeding.—(*a*) *The Sexes:* The sexes are evenly balanced. Out of 29 adults captured in 1917, 14 were males and 15

females. There is no sexual difference in the lengths of the developing young, and both sexes attain to a similar length in adult life. Males during advanced fœtal life have the genitalia extruded, and until they attain a length up to about 317 mm. (12½ inches). Shortly before birth, however, the genitalia become ensheathed. The claspers are not bifid, except at the extreme tip. In adult life males have the tubercles on the scales more pronounced than in females. I can discover no other differences in lepidosis in the sexes.

(*b*) *Method of Reproduction :* It is definitely known to be viviparous.

(*c*) *Season :* The young are born in the months of July and August, but it is probable that further observation will extend the season already known. I had several females in a very advanced stage of pregnancy late in June and early in July, but although I obtained 29 adults in those months in 1917, no snakeling of the year came to bag.

(*d*) *Period of Gestation :* Not known.

(*e*) *The Brood :* This species is one of the least prolific of all the snakes I know, and among seasnakes shares with *Enhydris curtus* this distinction. I have had eight gravid females, of which one contained a single embryo, five two embryos, one three, and one six. These were contained in the usual transparent sacs seen in viviparous snakes. Some of the sacs measured 100 mm. (4 inches) in length. The young are folded two or three times.

Growth.—(*a*) *The Young :* At birth the young measure from about 330 to 380 mm. (13 to 15 inches). I have seen specimens after birth of the former dimensions, and I have had unborn fœtuses that were 375 mm. (13¾ inches). In one case the united lengths of three fœtuses considerably exceeded the parent, the former aggregating 978 mm. (3 feet 2½ inches), and the latter 933 mm. (3 feet and ¾ of an inch).

(*b*) *Early Life :* The young appear to double their length in the first year of life, and are then about 635 to 760 mm. (25 to 30 inches) long.

(*c*) *Maturity :* I have had gravid females measuring 702, 705, 712, 730, and 737 mm. (27¼ to 29 inches). I think there can be no doubt that these were only one year old. If, as seems probable, the period of gestation is as protracted as in land snakes, such as *Vipera russelli*, then this species mates, and is sexually mature, when six months old.

(*d*) *Maximum Length :* My largest of well over sixty specimens was 933 mm. (3 feet and ¾ of an inch). Boulenger, however, gives 1,020 mm. (3 feet 8 inches) as the outside measurement.

Poison.—Nothing known. No casualties are on record, and the venom has not been experimented with.

Lepidosis.—This is one of the few hydrophids that shows wonderful constancy in the number and arrangement of its head shields.

(*a*) *Typical—Rostral :* Height greater than breadth ; slightly projecting downwards ; visible portion above subequal to or rather greater than the suture between the nasals. *Nasals :* No sutures radiate from the nostrils. *Præfrontals :* Touch the 2nd supralabials. *Frontal :* Entire ; longer than broad ; small, about two-fifths its distance from the end of the snout, and two-fifths the length of the parietals ; the fronto-parietal sutures subequal to, or a little longer than, the fronto-supraoculars. *Parietals :* Entire ; touching the postoculars. *Præoculars :* One. *Postoculars :* One. *Temporals :* One large anterior, as long as the supraocular ; and one posterior as large or larger. *Supralabials :* Six ; all entire ; the 1st and 2nd touching the nasals, 3rd and 4th the eye, 5th and 6th the anterior temporal, and the 6th the posterior temporal. *Sublinguals :* Two pairs, the fellows of each in contact ; the posterior touching the 3rd and 4th infralabials. *Infralabials :* Four ; the 1st longer than the suture between the anterior

sublinguals, 4th largest and in contact with two scales behind. *Cuneate:* None. (Fig. 62.)

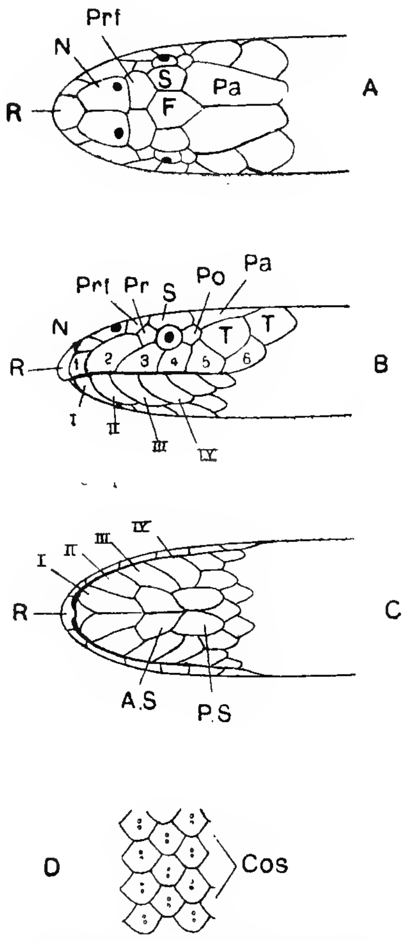

FIG. 62.—Microcephalophis gracilis.
(× 2.)
D. Costals.

Costals: Longer than broad, and imbricate on the slender anterior part of the body; as broad as long, hexagonal and juxtaposed on the compressed part of the body; with

figure-of-8 central tubercles; in 17 to 21 (usually 19) rows two heads-lengths behind the head; 26 to 32 in midbody; and 27 to 35 two heads-lengths before the vent. The tubercles are specially pronounced in old males. *Ventrals:* 217 to 290; entire; about twice the breadth of the last costals anteriorly; divided in the median line to form two apposed pentagons; each half about as broad as the last costals posteriorly; each divided half with twin spines directed backwards, and specially prominent in old males. *Anal:* Variable.

(*b*) *Anomalies—Præfrontals:* Rarely fail to meet the 2nd supralabial.

Dentition.—From two skulls in my collection. *Maxilla:* Postnodal, 5 to 6. *Palatine:* 8. *Pterygoid:* 9 to 12. *Mandibular:* 12 to 13.

Distribution.—(*a*) *General:* From the Persian Gulf to the Malay Peninsula.

(*b*) *Local:* From available records it appears uncommon in the Persian Gulf. On the Malabar Coast of India it is a fairly common species, and on the Coromandel Coast one of the commonest of hydrophids. In Madras I got 29 specimens in 1917 out of a total of 192. I found four in the Colombo Museum when I examined their collection. It is rare on the Burmese Coast and further East. Evans and I failed to secure a specimen from Burma, and the Indian Museum contains but one from the Mergui Archipelago. Annandale and Robinson obtained one off Patani in the Malay Peninsula, which was erroneously reported a *wrayi* by Boulenger (Fasc. Malay, 1903, p. 167). I pointed out the mistake in my Monograph (Mem. Asiat. Soc., Bengal, 1909, p. 213), which was acknowledged by Boulenger later (Faun. Malay Peninsula, 1912, p. 192).

MICROCEPHALOPHIS CANTORIS Gunther.

(Named after Dr. Cantor.)

Cantor's Seasnake.

Synonymy.—*Liopala fasciata, Hydrophis fasciata, H. gracilis, Distira gillespiæ.*

History.—The type was captured by Dr. Cantor off Penang in 1847, and confused by him with *gracilis* (Shaw).

Dr. Gunther first recognized it as a distinct species in 1864, and christened it.

General Characters.—A fine snake of large proportions growing to 6 feet. Head small, narrow, not depressed. Snout long, strongly declivous, bent down anteriorly, subconical. Eye very small. Commissure of the mouth shaped like an italic *f*. Neck not constricted. Body very thin and cylindrical for about two-fifths of its length anteriorly, becoming heavy and much compressed posteriorly ; and three times the anterior depth, or even four times in heavily gravid females.

Identification.—Easily distinguished by the figure-of-8 tubercles on the scales, 21 to 25 costal rows two heads-lengths behind the head, and ventrals ranging from 377 to 474. A very distinctive feature, only seen in one other seasnake, viz., *stokesi*, is that the præfrontal touches the 3rd supralabial.

Colouration.—Seaweed-green dorsally, merging to yellow ventrally. Encircled by 49 to 61 black rings on the body that dilate vertebrally. The anterior rings are extensively confluent, both vertebrally and ventrally, leaving oval yellow spots laterally. The posterior rings are usually incomplete ventrally. In the young the rings are well defined, but as age advances the definition becomes increasingly less. The head is uniformly black in the young, but fades to a dull dirty greenish with age.

Habits.—A large male brought to me was extremely active and muscular. It lay on its side, but in spite of vigorous action could not progress at all on land.

Food.—Nothing is known of any special fish selected.

Breeding.—(*a*) *The Sexes :* Nearly all my specimens have been males, and much the largest examples I have seen were males. In dissecting out the claspers of a large male, I noticed that the clasper tube is not bifid. As some of the seasnakes I have examined have exhibited bifid claspers, this is an observation of special interest. The tubercles are specially prominent in large males.

(*b*) *Method of Reproduction:* Definitely known to be viviparous.

(*c*) *Season.*—The one gravid female known to me was killed by Mr. Kemp on September 9, 1919.

(*d*) *Period of Gestation:* Not known.

(*e*) *The Brood:* Mr. Kemp's gravid female preserved in the Indian Museum contained six ova containing embryos in a very early stage of development. These measured about 50 mm. (2 inches) in length.

Growth.—(*a*) *The Young:* The length of the young at birth is not known.

(*b*) *Maturity:* The gravid female sent to me for identification by Dr. Annandale measured 1,155 mm. (3 feet 9½ inches).

(*c*) *Maximum Length* The largest males I have measured were 1,410 and 1,322 mm. (4 feet 7½ inches and 4 feet 4 inches). The largest female known to me was 1,155 mm. (3 feet 9½ inches). A very large example in the Indian Museum, sex not noted, measures 1,855 mm. (6 feet 1 inch).

Poison.—Nothing known. It has not been experimented with in the laboratory.

Lepidosis.—Unlike so many of the seasnakes the lepidosis of the head preserves a wonderful constancy.

(*a*) *Typical—Rostral:* Deeper than broad; produced slightly downwards; the visible portion above nearly or quite as long as the suture between the nasals. *Nasals:* Sutures from the nostril passing backwards to the præfrontals and outwards to the 2nd supralabial. *Præfrontals:* Touch the 3rd supralabial. *Frontal:* Entire; about two-thirds its distance to the end of the snout, and two-thirds the parietals. *Parietals:* Entire; touching the postoculars. *Præocular:* One. *Postocular:* One. *Temporals:* A large anterior, followed by an equally large or even larger shield posteriorly. *Supralabials:* Six; all entire; the 1st, 2nd, and 3rd touching the nasals; 3rd and 4th the eye; 5th and 6th the anterior temporal, and the 6th the posterior temporal. *Sublinguals:* Two well-developed pairs; the fellows of both in contact with one another. *Infralabials:* Four; the 4th touching two

scales behind ; the suture between the first as long as or longer than that between the anterior sublinguals. *Cuneate :* None. (Fig. 63.)

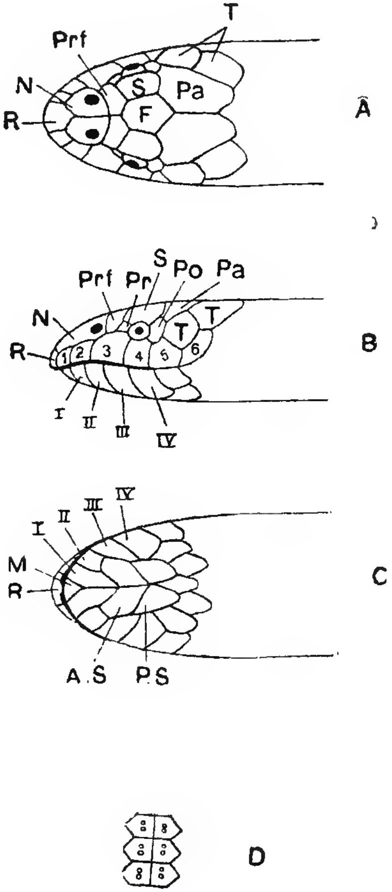

FIG. 63.—Microcephalophis cantoris.

(Life size.)

D. Ventrals.

Costals : Longer than broad anteriorly, as broad as long posteriorly; imbricate on the attenuated forebody; juxtaposed and hexagonal on the compressed posterior part; with small, figure-of-8 tubercles centrally, one behind the other. In 23 to 25 (rarely 21) rows two heads-lengths behind the head; 27 to 36 in midbody: and 36 to 46 rows two heads-lengths before the vent. *Ventrals :* 377 to 474; entire, and about twice the breadth of the last row anteriorly; divided in the middle line in midbody and posteriorly to form two apposed pentagons; each half being about as broad as the last costal row; with twin tubercles on each divided half.

(*b*) *Anomalies—Nasals :* Sometimes there are no sutures from the nostril. *Præfrontals :* Rarely touch the 2nd as well as the 3rd supralabials. *Postoculars :* Rarely two. *Supralabials :* Rarely the 1st and 2nd only touch the nasals. *Sublinguals :* The posterior pair rarely separated by one scale.

Dentition.—From three skulls in my collection. *Maxillary :* Postnodal, 5 to 6. *Palatine :* 7. *Pterygoid :* 7 to 8. *Mandibular :* 11 to 13.

Distribution.—(*a*) *General :* From the Sind Coast to Chittagong. Malay Peninsula (Boulenger).

(*b*) *Local :* An uncommon snake. The type of Boulenger's *gillespiæ* was killed at Karachi. There are three examples in the Bombay Natural History Society's collection from Karwar. Kemp's specimen in the Indian Museum is from Marmagoa Bay. I obtained one specimen at Cannanore. There is no specimen in the Trivandrum Museum. It is not represented in the Colombo Museum, nor can I find any record from Ceylon. I procured three out of a total of 192 seasnakes from Madras in 1917, and had two others sent to me from the same locality by Dr. Henderson. There are twelve specimens in the Indian Museum and one in the British Museum from the Coast of Orissa and the Sunderbunds. I have had one from Chittagong. I can find no record from the Burmese Coast. A specimen of Cantor's in the British Museum is labelled "Penang."

Genus PORRECTICOLLIS Gen. nov.

(Latin " porrectus " stretched, " collis " neck.)

General Characters.—Length moderate. One of the five very slender-necked species; the diameter anteriorly one-third to one-fifth that of the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals:* Sutured to præfrontals and frontal; longer than frontal. *Præfrontals:* Meeting parietal, but not postfrontals. *Frontal:* As broad as long; not meeting postfrontal at rim of orbit. *Parietal:* Not keeled inferiorly. *Quadrate:* Vertical; extreme length superiorly equal to its own depth. *Maxilla:* Not extending beyond palatine anteriorly, but extending beyond palatine posteriorly.

Dentition.—From one skull in my collection. *Maxillary:* Postnodal, 4 to 6; scaphiodont. *Palatine:* 7; anododont, isodont; no edentulous space posteriorly. *Pterygoid:* 10; anododont, scaphiodont; posterior half edentulous. *Mandibular:* 15; anododont, scaphiodont.

There is one species, viz., *obscurus.*

Porrecticollis obscurus (Daudin).

(Latin " obscurus " dark.)

Russell's Seasnake.

Tamil: " shootur sun," " kala shootur sun " (Russell).

Synonymy.—*Hydrophis obscurus, H. chloris, H. coronatus, H. latifasciatus, Pelamis obscurus, P. chloris, Distira obscura.*

General Characters.—A snake of fair proportions, growing to 4 feet in length. Head small, elongate, not depressed. Snout long, moderately declivous, subconical, turned down slightly terminally. Eye small. Commissure of mouth turned up behind. Neck not contracted. Body cylindrical and slender in the anterior two-fifths, the depth about one-third to one-fifth the depth at greatest girth; much compressed and heavy in the posterior three-fifths.

Identification.—The costals 19 to 23 two heads-lengths behind the head, taken with the imbricate scales in from 25 to 32 rows at the greatest girth and ventrals numbering 277 to 354, will suffice to distinguish it from other hydrophids.

Colouration.—The young are very handsome, being bright yellow, banded with from 34 to 60 broad black bands. These

bands are well defined, expand vertebrally, and are extensively confluent vertebrally and ventrally on the slender part of the body, leaving oval yellow lateral patches. As age advances the yellow fades to dull-grayish or bluish, and the black to dull-greenish, the bands become less and less defined, disappear first ventrally leaving dorsal bars, and finally may disappear completely. The head in the young is black, with a complete or a disconnected horseshoe mark, the convexity of which lies across the præfrontals. As age advances this becomes more and more obscure, and the black resolves into a dull-bluish or olivaceous hue.

Habits.—Dr. Annandale, who is intimately acquainted with it, remarks that it is mainly, but not exclusively, an inhabitant of brackish water. I have had it from Watiya, Burma, 40 miles up river. It frequents both open water and the shallow weedy edges of the Chilka Lake. Dr. Annandale frequently observed it with its head and forebody thrust vertically out of the water.

Food.—Dr. Annandale says among other fish it will swallow *Triacanthus brevirostris*, a species that bears a pair of long and stout spines on the belly, which it can thrust out and maintain so rigidly that they cannot be bent back without being broken. It sometimes happens that when this fish has been swallowed, the spines become locked in the stomach, and pierce that organ or the intestine, and work their way out through the tissues and skin, without imperilling the life of the snake!

Breeding.—(*a*) *The Sexes*. Both sexes grow to a similar length. The male in its adult state is a rougher snake from the development of its keels.

(*b*) *Method of Reproduction* : It is definitely known to be viviparous.

(*c*) *Season* : Not known.

(*d*) *Period of Gestation* : Not known.

(*e*) *The Brood* : From five to ten young are produced at a time. The type contained nine young, and I have examined three other gravid females, one with five sacs, one with six, and a third with ten young.

Growth.—(*a*) *The Young :* One of the embryos extracted from the type specimen was 332 mm. (14¼ inches) long. How much more these were destined to grow before birth it is impossible to say, but it seems probable that they had acquired their full prænatal development, as the young of *cantoris*, a much larger snake, are only 330 to 373 mm. (13 to 14¾ inches) long at birth.

(*b*) *Early Life :* I have not been able to follow the growth.

(*c*) *Maturity :* My smallest gravid female was 750 mm. (2 feet 5½ inches).

(*d*) *Maximum Length :* The type is the largest of about twenty specimens examined by me, and measures 1,029 mm. (3 feet 11 inches). Dr. Annandale has reported one 1,220 mm. (4 feet) in length.

Poison.—Nothing known. No casualties have been reported. and the venom has not been experimented with.

Epizoa and Epiphyta.—Dr. Annandale remarks that he has found no hydroids nor barnacles attached to this species.

Lepidosis.—The head shielding is wonderfully constant in its arrangement.

(*a*) *Typical—Rostral :* Broader than deep ; slightly projecting downwards ; the visible portion above half to three-fifths the suture between the nasal shields. *Nasals :* Usually with one suture passing to the 2nd supralabial. *Præfrontals :* Touching the 2nd supralabials. *Frontal :* Entire ; longer than broad ; the fronto-parietal sutures longer than the fronto-supraoculars. *Parietals :* Entire ; touching the postoculars. *Præoculars :* One. *Postoculars :* One. *Temporals :* A large anterior which is as long as or longer than the supraocular, followed by as large or a larger posterior. *Supralabials :* Six or seven ; the anterior five large, 6th and 7th small, the 6th usually confluent with the anterior temporal, which thus descends to the margin of the lip ; 1st and 2nd touching the nasals ; 3rd and 4th the eye ; 5th and 6th the anterior temporal ; and the 6th usually the posterior temporal. *Sublinguals :* Two pairs, the fellows of each in contact. *Infralabials :* Four ; the 1st as long as or longer than the anterior sublinguals, 3rd and 4th touching the posterior sublinguals ; 4th largest and

touching three or four scales behind. *Cuneate:* One, small between the 3rd and 4th infralabials.

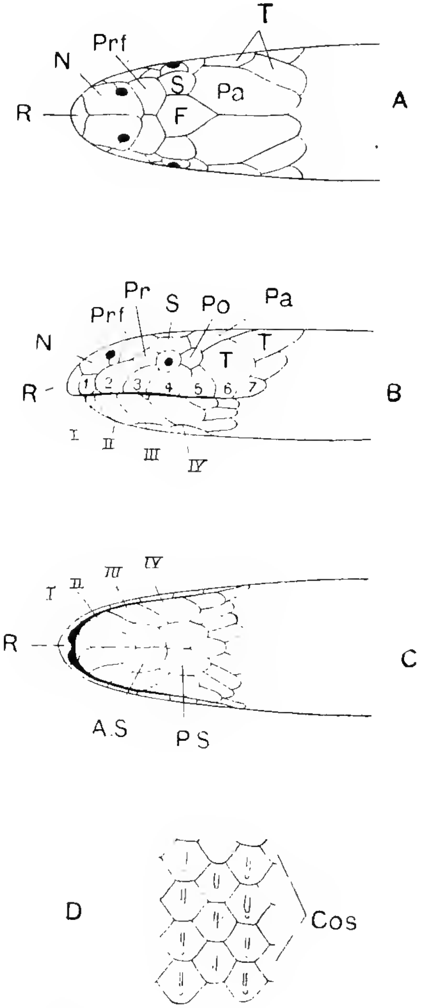

FIG. 64.—Porrecticollis obscurus.
(× 2.)
D. Costals.

Costals : Longer than broad on the constricted anterior part of the body, about as broad as long on the compressed part; imbricate everywhere; with short bidentate keels about the median two-fourths of each scale, the anterior tooth much longer than the posterior, which is minute. 19 to 23 rows two heads-lengths behind the head; 25 to 32 in midbody; and from 26 to 33 two heads-lengths before the vent. *Ventrals :* 277 to 354; entire throughout, and nearly twice as broad as the last costals.

(*b*) *Anomalies—Præocular :* Very rarely absent. *Supralabials :* The 6th sometimes separated from the posterior temporal by one scale. *Sublinguals :* The fellows of the posterior pair are rarely separated by one scale.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* From Karwar on the Coromandel Coast of India to Mergui on the Tenasserim Coast.

(*b*) *Local :* Of twenty specimens examined by me only two are from the Coromandel Coast, both from Karwar. I failed to get it at Cannanore, and it is not represented in the Trivandrum Museum. I saw no example in the Colombo Museum, and there is no record of one from Ceylon. Most of the specimens are from the Chilka Lake, where it is a fairly common snake. Dr. Annandale tells me that it appears to be the only hydrophid inhabiting that water. The type (and also the type of Daudin's *chloris*) is from the Sunderbunds, and I have seen several other specimens from the same locality and the Hoogly river. I have had one from Chittagong, three from the Burmese Coast, and have seen two others from Mergui. The type of Gunther's *latifasciatus* is also from Mergui.

Genus DOLICHODIRA Gen. nov.

(Greek " dolichos " long, " dira " neck.)

General Characters.—Length moderate. One of the five very slender-necked species, the diameter of the body anteriorly one-third to one-fourth the extreme depth posteriorly.

Cranial Osteological Characters—*Nasals :* Sutured to frontal and præfrontals, longer than frontal. *Præfrontals :* Meeting parietal and postfrontals. *Frontal :* As broad as long; not meeting postfrontal at rim of orbit. *Parietal :* Not keeled

inferiorly. *Quadrate :* Vertical; extreme length superiorly equal to its depth. *Maxilla :* Not extending beyond palatine anteriorly, but extending beyond palatine posteriorly.

Dentition.—From three skulls in my collection. *Maxillary :* Postnodal, 7 (? 6) to 10; feebly scaphiodont. *Palatine :* 8 to 10; anododont, isodont; no edentulous space posteriorly. *Pterygoid :* 18 to 24; anododont, scaphiodont; posterior half edentulous. *Mandibular :* 18 to 20; anododont, feebly scaphiodont.

There is only one species, viz., *diadema*.

Dolichodira diadema (Gunther).

(Latin " diadema " a head dress, refers to the yellow horseshoe mark on the crown.)

Gunther's Seasnake.

Synonymy.—*Hydrophis stricticollis, H. obscurus, H. torquatus, H. nigrocinctus, Distira lapemidoides, D. torquatus.*

History.—Described and christened by Gunther in 1864 from three specimens in the British Museum.

General Characters.—A snake of fair proportions, growing to 3½ feet. Head small, elongate, not depressed. Snout long, bluntly conical, projecting slightly downwards. Eye small. Commissure of mouth shaped like an italic *f*. Neck not apparent. Body cylindrical and very slender in about the anterior two-fifths; compressed and heavy in the posterior three-fifths.

Identification.—The scale rows 30 to 41 two heads-lengths behind the head, ventrals 374 to 460, taken with the juxtaposed character of the scales on the compressed posterior part of the body, will indicate the species.

Colouration.—Olivaceous dorsally, merging to yellowish ventrally. Forty to sixty-five well-defined black rings encircle the body. These are about as broad as the intervals at midcosta and expand somewhat vertebrally, but remain discrete ventrally. They are sometimes interrupted in the posterior part of the body, and tend to lose definition as age advances. The head is black, with a more or less distinct yellow horseshoe mark above, especially conspicuous in the young.

Habits.—It is not unusual for it to come up tidal rivers forty or fifty miles from the sea.

Food.—No special observations have been made concerning its diet.

Breeding.—(*a*) *Method of Reproduction:* There is no authentic information on this point.

(*b*) *Season:* My one gravid female had no date of capture recorded.

(*c*) *The Brood:* A specimen from Burma contained nine eggs measuring 38 by 19 mm. (1½ by ¾ of an inch). An egg opened by me contained no trace of an embryo, but was probably infertile.

Growth.—(*a*) *The Young:* The length of the young when embarking on independent life is not known, but the type of *stricticollis* (Gunther) in the British Museum is only 343 mm. (1 foot 1½ inch), and appears to be but recently born.

(*b*) *Maturity:* The gravid female above referred to was 1,055 mm. (3 feet 5½ inches).

(*c*) *Maximum Length:* 1,055 mm. (3 feet 5½ inches) is the largest measurement I know of.

Poison.—Nothing known. No experiments have been carried out, and no casualties are on record

Lepidosis.—(*a*) *Typical—Rostral:* Broader than deep; the portion visible above half to two-thirds the suture between the nasals. *Nasals:* A single suture usually proceeds from the nostril to the 2nd supralabial. *Præfrontals:* Touch the 2nd supralabials. *Frontal:* Entire; longer than broad; the fronto-parietal sutures rather longer than the fronto-supra-oculars. *Supraoculars:* Length two-thirds to three-fourths the frontal; breadth two-thirds to three-fourths the frontal. *Parietals:* Entire; touching the postoculars. *Præoculars:* One. *Postoculars:* One. *Temporals:* One, well-developed anterior, with sometimes a well-developed posterior. *Supra-labials:* Seven or eight; the first four or five usually large, the rest small; 1st and 2nd touching the nasals, 3rd and 4th the eye. *Sublinguals:* Two pairs; the fellows of the posterior in contact or separated by one scale. *Infralabials:* Four; the suture between the first shorter than that between the

anterior sublinguals ; fourth largest and in contact with three or four scales behind. *Cuneate:* One between the 3rd and 4th infralabials.

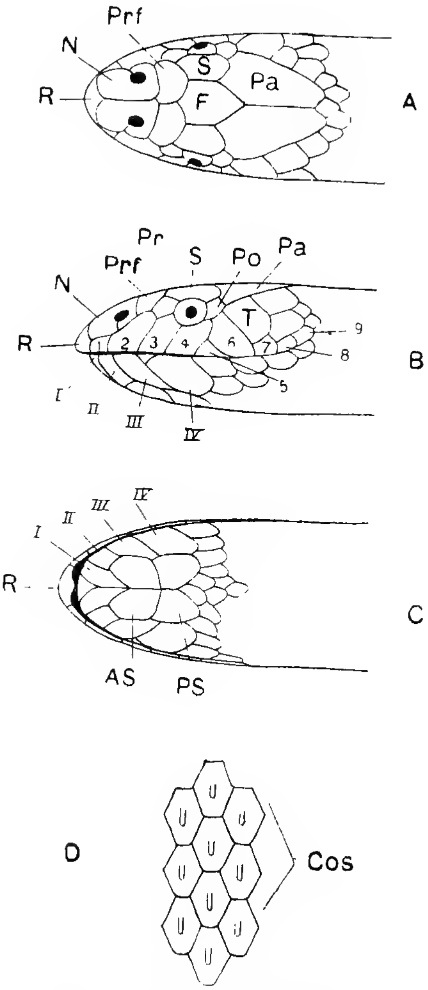

FIG. 65.--Dolichodira diadema.
(× 2.)
D. Costals.

Costals : Longer than broad, and imbricate in the slender anterior part of the body ; as broad as long, subimbricate or juxtaposed in the posterior compressed part. A short keel occupies about the median third of the scales. In 32 to 41 rows two heads-lengths behind the head ; 37 to 54 in midbody ; and 34 to 46 two heads-lengths before the vent. *Ventrals :* 374 to 460 (305 to 438, Boulenger) ; entire throughout ; nearly twice the breadth of the last costals.

(*b*) *Anomalies—Præfrontals :* Do not touch the 2nd supra labial on one side in one specimen. *Postoculars :* None on one side in one specimen ; two and three on one side in two others. *Temporals :* The anterior is broken up into two or three parts on one side in three examples. *Supralabials :* The 3rd, 4th, and 5th touch the eye on one side in four examples. *Cuneate :* Rarely two after the 3rd, or more rarely still after the 2nd infralabials.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* Coasts from the Sunderbunds to Burma (Siam and Borneo, Boulenger).

(*b*) *Local :* I have examined seventeen examples apart from those in the British Museum. There are no records from the Coromandel Coast south of the Sunderbunds The British Museum has a specimen from Sandheads, Hugli river, and there are two others from the Hugli river in the Indian Museum. I have had three from Chittagong and eight from the coasts of Burma. Two in the British Museum are from the Pegu Coast, and two others from the Bassein river. Gunther's type of *stricticollis* is labelled Bay of Bengal. One in the British Museum is from the Siamese Coast and one from Borneo.

HYDROPHIS TORQUATUS Gunther.

This species, which is apparently very closely allied to *diadema,* is based on five specimens in the British Museum. Boulenger gives the habitat as " Bay of Bengal and Straits of Malacca." I have not included them in this work, as Gunther says that four of these were collected by Cantor off the coast

of Penang. Further, I have never examined any snake from the Indian Coasts that fits the description given by Boulenger (Fauna Malay Penin, 1912, p. 190).

Genus ATURIA.

(Der. not known to me.)

General Characters.—Length rather small. One of the five very slender-necked species. The diameter of the neck about one-third to one-fourth that of the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals :* Sutured to præfrontals and frontal ; as long as the frontal. *Præfrontals :* Not meeting parietal or postfrontals. *Frontal :* As broad as long ; meeting postfrontals at rim of orbit. *Parietal :* With no keel inferiorly. *Quadrate :* Vertical ; extreme length superiorly, equal to its depth. *Maxilla :* Not extending beyond palatine anteriorly, but extending beyond palatine posteriorly.

Dentition.—From two skulls in my collection. *Maxillary :* Postnodal, 5 to 6 ; isodont. *Palatine :* 7 to 8 ; anododont, isodont ; no edentulous space posteriorly. *Pterygoid :* 8 to 10 ; anododont, isodont ; posterior half edentulous. *Mandibular :* 13 to 15 ; anododont, feebly scaphiodont.

There is only one species, viz., *fasciata.*

ATURIA FASCIATA (Schneider).

(Latin "fasciatus" banded.)

Schneider's Seasnake.

Tamil : "milagu kadyen" (pepper biter) (Henderson).*

Synonymy.—*Hydrus fasciatus, Pelamis fasciatus, Hydrophis gracilis, H. obscura, H. lindsaya, H. atriceps, H. melanocinctus, H. cantoris, H. leptodira, H. brookii, Aturia lindsayi, Disteira fasciata, B. rhombifer.*

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* One of the snakes, I am told by Dr. Henderson, that the fishermen about Madras attach this name to, the head being fancifully likened to a peppercorn.

History.—Described and christened by Schneider in 1799.

General Characters.—A rather small species, growing to 3 feet or slightly over. Head very small, elongate, not depressed. Snout long, strongly declivous, subconical terminally. Eye small. Commissure of mouth turned up posteriorly. Neck not constricted. Body cylindrical and slender in about its anterior two-fifths; compressed and rather heavy in the posterior three-fifths.

Identification.—Known by the following features: The round eccentric tubercle on the scales, scale rows 25 to 33 two heads-lengths behind the head, and 376 to 513 ventrals.

Colouration.—In this it resembles *gracilis* very closely. Young specimens are olivaceous-green dorsally, this hue merging to pale-gray or whitish ventrally. The body is surrounded with from 48 to 71 well-defined black bands, which are expanded vertebrally. In the slender forebody the bands are extensively confluent vertebrally and ventrally, leaving oval lateral islets of pale gray. As age advances the definition of these bands reduces more and more and the bands disappear ventrally, leaving in time only a series of dorsal black rhombs. The head is entirely black in the young, but in time, like the body bands, its intensity fades considerably.

Habits.—There is nothing distinctive to remark upon.

Food.—No special observations have been made on the fish furnishing its diet.

Breeding.—(*a*) *The Sexes:* Males have the tubercles on the keels more pronounced than the females.

(*b*) *Method of Reproduction:* It is known to be viviparous.

(*c*) *Season:* A gravid female preserved in the Bombay Natural History Society's collection has no date of capture recorded, nor is there a date available for Gunther's type of *brookii*. Two were procured for me at Madras, one between

June 20 and 30, the other on July 3, 1917. In both specimens parturition appeared to be imminent.

(*d*) *The Brood :* Both my specimens just referred to contained four sacs, the longest of which measured 70 mm. ($2\frac{3}{4}$ inches). I have seen a third specimen which held two sacs.

Growth.—(*a*) *The Young :* The eight unborn embryos extracted from my two gravid females varied in length from 342 to 378 mm. ($13\frac{1}{2}$ to $14\frac{7}{8}$ inches).

(*d*) *Maturity* My gravid females measured respectively 915 and 953 mm. (3 feet and 3 feet $1\frac{1}{2}$ inches). A gravid Madras specimen preserved in Bombay is 788 mm. (2 feet 7 inches).

(*c*) *Maximum Length :* Boulenger gives the longest measurement in the British Museum as 1,000 mm. (3 feet $3\frac{1}{2}$ inches). Murray gives the length of a Karachi specimen (*H. lindsayi*) as 1,042 mm. (3 feet 5 inches).

Poison.—No casualties referable to this snake have been reported, and no experiments have been made with the venom.

Lepidosis.—(*a*) *Typical—Rostral :* Rather broader than high ; not projected below the level of the lip ; visible portion seen above half to three-fifths the suture between the nasals. *Nasals :* If a suture proceeds from the nostril, it passes to the 2nd supralabial. *Præfrontals* : Touch the 2nd supralabial. *Frontal :* Entire ; longer than broad ; the fronto-supraocular sutures subequal to or rather longer than the fronto-supraoculars. *Parietals :* Entire ; touching the postocular. *Præocular :* One. *Postocular :* One. *Temporals :* One large anterior shield, succeeded by a large posterior, which is as large or even larger. *Supralabials :* Six or seven, not subject to division ; the first five large ; 1st and 2nd touching the nasals ; 3rd and 4th the eye ; 5th and 6th, or 5th, 6th, and 7th the anterior temporal ; last not touching the posterior temporal. *Sublinguals :* Two pairs, the fellows of each in contact with one another. *Infralabials :* Four ; the suture between the 1st as long as or longer than that between the anterior sublinguals ; 3rd or 4th touching the posterior sublinguals ; 4th

largest, touching 3 or 4 scales behind. *Cuneate :* One between the 3rd and 4th infralabials (Fig. 66.)

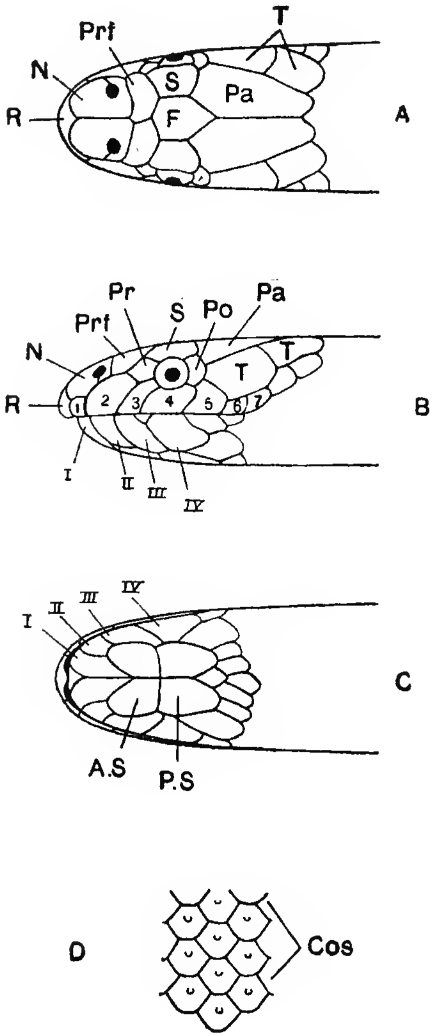

FIG. 66.—Aturia fasciata.
D, Costals.

Costals : Longer than broad and imbricate on the slender part of the body; about as long as broad, subimbricate or juxtaposed on the compressed part; with a small, round, slightly eccentric tubercle. In 25 to 33 rows two heads-lengths behind the head; 37 to 57 in midbody; and 37 to 57 two heads-lengths before the vent. *Ventrals :* 376 to 513.* Entire everywhere, nearly twice the breadth of the last row. *Anal :* Variable.

(*b*) *Anomalies—Præfrontals :* Rarely quite separated by the anterior angle of the frontal as in the type of *brookii ;* rarely fail to touch the 2nd supralabial, the præocular meeting the nasal. *Postoculars.* Rarely two. *Temporals :* The anterior is rarely confluent with the subjacent supralabial and so reaches the margin of the lip. The posterior rarely touches the last supralabial; very rarely divided, but I have never seen this on both sides in one specimen. *Sublinguals :* The fellows of the posterior pair rarely separated by one scale. *Cuneate :* Sometimes two after the 2nd or 3rd infralabial.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* From the Malabar Coast of India to New Guinea and China.

(*b*) *Local :* It is apparently extremely rare on the Malabar side of India, for I can find only two records, viz., the specimen so labelled in the British Museum and one mentioned by Murray (*lindsayi*) from Karachi. There is no specimen in the Bombay Natural History Society's collection from that coast. I have failed to get a specimen and there is no example in the Trivandrum Museum. There is no record from Ceylon, and the one specimen so labelled in the Colombo Museum and mentioned by Haly proved to be a *cyanocinctus.* It is a fairly common snake at Madras and all the way up the coast to the Sunderbunds. I have seen one from Akyab, but none from the Burmese Coast. The only records further East are the two types of Gunther's *atriceps* obtained through Jamrach, said to be from Siam; Cantor's one specimen labelled "Penang": the type of Boulenger's *rhombifer* from Perak; the type of

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* Not 531, as erroneously printed in my Monograph (p. 206).

Gunther's *brookii* from Borneo; Bleeker's two specimens labelled "Malay Archipelago," with no exact locality specified; and the type of Gray's *lindsayi* from China. Its favoured haunt is, therefore, between Madras and Calcutta. I have examined over forty specimens.

Genus LIOSELASMA.

(Greek " leios " smooth, " selas " bright.)

General Characters.—Length moderate to long. Body moderately attenuated anteriorly, the diameter about two-fifths to one-third the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals :* Sutured to præfrontals and frontal; longer than frontal. *Præfrontals :* Meeting parietal and postfrontals. *Frontal :* As broad as long; not meeting postfrontal at rim of orbit. *Parietal :* Not or but feebly keeled inferiorly. *Quadrate :* Oblique from above backwards; extreme length superiorly three-fourths to four-fifths its depth. *Maxilla :* Not extending beyond palatine anteriorly; extending beyond palatine posteriorly.

Dentition.—From three species. *Maxillary :* Postnodal, 6 to 10; isodont. *Palatine :* 5 to 9; anododont, isodont; no edentulous space posteriorly. *Pterygoid :* 12 to 21; anododont, isodont, or feebly scaphiodont; posterior two-fifths edentulous. *Mandibular :* 13 to 20; anododont, feebly scaphiodont.

There are four species, viz., *spiralis*, *cyanocincta*, *bituberculata*, and *mamillaris*.

Lioselasma mamillaris (Daudin).

(Latin " mamilla " a breast. The small central tubercle on each scale reminds one of the nipple on a breast.)

The Broad Banded Seasnake.

Telugu : "tatta pam" (Russell), should be " thatta pam " (flat snake).

Synonymy.—*Anguis mamillaris*, *Hydrophis fasciata*.

History.—Daudin's name given in 1802 refers to Plate XLIV. of Russell's first volume.*

General Characters.—A rather small snake, growing to about 2½ feet. Head small, elongate, not depressed. Snout moderate in length, slightly projecting, declivous, obtusely rounded terminally. Eye rather small. Commissure of mouth slightly turned up behind. Neck not contracted. Body slender and cylindrical in its anterior two-fifths; compressed and rather heavy in the posterior three-fifths; the greatest depth being three or four times that of the slender anterior part.

Identification.—The following syndrome will establish its identity: Scales with a round eccentric tubercle, costal rows two heads-lengths behind the head 25 to 29, and from 316 to 367 ventrals. The breadth of the black bands, which are broader than the inter-spaces at midcosta, will afford a useful clue to its identity, as no other Indian seasnake has bands so broad.

Colouration.—The body is yellowish or grayish, encircled by from 40 to 56 (58 Russell) broad black bands. These bands are broader than the intervals at midcosta, expand but are not confluent vertebrally, and are extensively confluent ventrally. In some old specimens the bands become obliterated ventrally, and converted into bars, which are well defined and retain their definition in adult life. The head is entirely black, or may exhibit some obscure yellow postocular mottling. The tail is black, with from one to six or more light rings interrupted ventrally.

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* The identity of the snake therein represented is, in my opinion, a matter of conjecture. The data in the description are insufficient to establish its identity, and would equally fit *fasciatus* or *gracilis*. The figure too might represent either of these two species. Possibly the breadth of the bands led both Gunther and Boulenger to identify the snake with the species now known under the name of *mamillaris*. It is unfortunate that the subject from which the plate was drawn has been lost sight of. In the Museum of the Royal College of Surgeons, where Russell's collection was originally deposited, I found a specimen of *mamillaris* (No. 521 C.) without history, but it is evidently not the subject of the plate referred to, as it has 47 bands on the body and the tail is wholly black. Russell's description says the snake had 58 light bands, and the plate shows light hands in the whole length of the tail.

Habits.—There is nothing known that calls for special remark.

Food.—No special observations have been made on its diet.

Breeding.—(*a*) *Season :* This is not known, the one gravid female known to me having no record of its date of capture.

(*b*) *Method of Reproduction :* Definitely known to be viviparous.

(*c*) *Period of Gestation :* Not known.

(*d*) *The Brood :* The single gravid female on record contained three embryos and one unfertilized egg. The birth of the young appeared imminent, as none had the genitalia protruding (unless all were females). They measured from 305 to 307 mm. (12 to 12⅛ inches).

Growth.—(*a*) *The Young :* The exact length of the young at birth is not known.

(*b*) *Maturity :* The gravid specimen above alluded to was 832 mm. (2 feet 8¾ inches) in length.

(*c*) *Maximum Length :* 832 mm. (2 feet 8¾ inches) is the longest measurement I know.

Poison.—Nothing known.

Lepidosis.—Except for the posterior labials and temporals, the lepidosis of the head is remarkably constant.

(*a*) *Typical—Rostral :* The portion visible above is from half to three-fifths the suture between the nasals. *Nasals :* Sutures usually radiate from the nostril to the præfrontal and the 2nd supralabial. *Præfrontals :* Touch the 2nd supralabial. *Frontal :* Longer than broad ; the fronto-parietal sutures rather longer than the fronto-supraoculars. *Parietals :* Entire ; touching the upper postoculars. *Præocular :* One. *Postoculars :* Two. *Temporals :* Small and very variable, not deserving recognition as such. Sometimes one well-developed anterior, more often two or three, small scales. *Supralabials :* Seven ; the first four entire, the posterior subject to division ; 1st and 2nd touching the nasals ; 3rd and 4th the eye. *Sublinguals :* Two pairs ; the fellows of each in contact with one another. *Infralabials :* Four ; the suture between the 1st shorter than that between the anterior sublinguals ; 4th

largest, and touching three or four scales behind. *Cuneate :* One between the 3rd and 4th infralabials. (Fig. 67.)

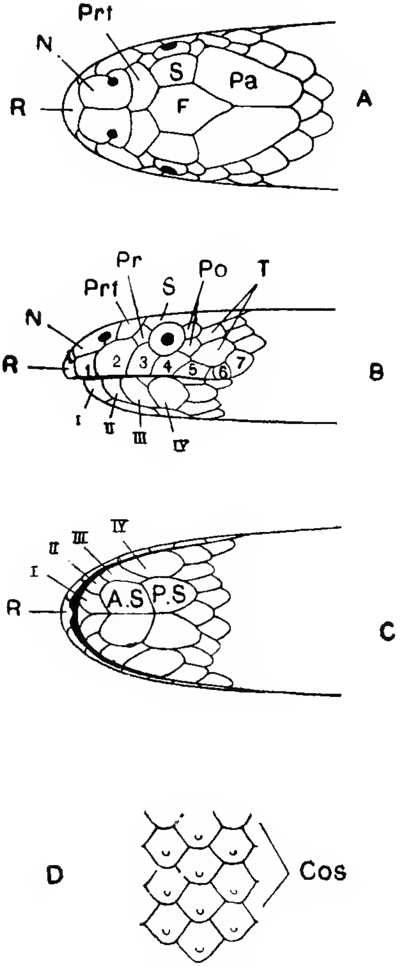

FIG. 67.—Lioselasma mamillaris.

(× 2.)

D. Costals.

Costals: Longer than broad and imbricate on the slender anterior part of the body; as broad as long, hexagonal and juxtaposed on the compressed posterior part; with a slightly eccentric tubercle on each scale. In 25 to 29 rows two heads-lengths behind the head; 31 to 40 in midbody; and 34 to 41 two heads-lengths before the vent. *Ventrals:* 316 to 367 (287 Boulenger); nearly twice the breadth of the last costal rows in the whole body length. *Anal:* Variable.

(*b*) *Anomalies—Cuneate:* Sometimes two after the 3rd infralabial; absent on one side in one example.

Dentition.—*Maxillary:* Postnodal, 7 to 10.* *Palatine:* 5. *Pterygoid:* 20 to 21. *Mandibular:* 19 to 20.

Distribution.—(*a*) *General:* Coasts of Peninsular India. (*b*) *Local:* The subject of Russell's Plate XLIV., the identity of which I hold as dubious, was killed at Vizagapatam. The point, however, is not an important one, as the British Museum possesses another specimen from Vizagapatam presented by Colonel Beddome. Every other specimen known to me was killed in the immediate vicinity of Bombay, It is apparently a rare snake. I have only seen eight examples, including those in the British Museum. The specimen in the Indian Museum, referred to by me in my Monograph (No. 13,392), from the Bay of Bengal, on a more critical examination, I now consider an unusual *cyanocincta.*

LIOSELASMA SPIRALIS (Shaw).†

(Greek "speira" a wreath or coil.)

The Narrow Banded Seasnake.

Tamil: "kadel nagam" (seasnake) about Madras, and "kadel pambu" (seasnake) on the Malabar Coast.

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* I have counted these in several specimens.

† My conception of the species as herein presented is based on a study of well over sixty specimens from Indian Coasts (*i.e.*, Persian Gulf to Tenasserim). I have not incorporated any of the many species of other authors from further East, the validity of which I gave reasons in my Monograph (Memoirs of the Asiatic Society of Bengal, 1909) for doubting.

Synonymy.—*Hydrus spiralis, Enhydris spiralis, Hydrophis nigrocinctus, H. robusta, H. rappii, H. temporalis, H. bishopi, H. sublævis, H. alcocki, H. cyanocincta, Chitulia fasciata, Distira robusta, D. brugmansi.*

History.—The type which is in the British Museum is a young specimen, one of Russell's collection, labelled "Indian Ocean." It was probably obtained on the Coromandel Coast, like all Russell's other specimens. It was christened by Shaw in 1802.

General Characters.—The largest of the seasnakes, growing exceptionally to 8 and 9 feet. Head moderately large and broad, little, if at all, depressed. Snout rather long, declivous, broadly rounded and hardly projecting terminally. Eye small. Nostril moderate in size. Commissure of mouth much turned up posteriorly. Neck not or hardly apparent. Body unusually elongate, cylindrical, and moderately robust in about the anterior two-fifths; moderately compressed and robust in the posterior three-fifths.

Identification.—The costals imbricate everywhere, and with a round central tubercle, in 25 to 31 rows two heads-lengths behind the head, and 29 to 36 at the greatest girth will distinguish this from other seasnakes. I find a reliable method is to count the scale rows two heads-lengths behind the head and two heads-lengths before the vent. The posterior count only exceeds the anterior by from two to six. The narrow bands will attract attention, and suggest the identity of the species.

Colouration.—The head in the young is black, with a more or less distinct yellow horseshoe mark on the crown. The black fades as age advances, and the head may ultimately become a light olivaceous, with obscure yellow mottlings, or may be suffused with pink. The body is olivaceous dorsally, merging to yellow ventrally, and is adorned with from 34 to 70 black bands or bars. These bands are very variable. In most examples they are half or less than half the intervals at midcosta. In some they are of even

breadth, in some dilated vertebrally, in others they taper ventrally. Some of the posterior are sometimes interrupted costally. In some the black is preserved for a variable extent dorsally, and becomes almost obsolescent ventrally. In some the bands are discrete vertebrally and ventrally, and in others they become more or less confluent vertebrally, and more or less connected by a broad stripe ventrally. The various colour varieties may be grouped as follows :—

A.—Bands complete throughout.

(1) *brugmansi* (Boie) ; vel. *bishopi* (Murray). With bands narrower than the interspaces and unconnected vertebrally. No vertebral nor ventral spots in the intervals. Very analogous to variety B of *cyanocincta*. One of the commonest varieties.

(2) *spiralis* (Shaw). Differing from the last only in exhibiting one or more single vertebral spots in the interspaces. There are usually only a few such spots anteriorly and posteriorly, but rarely there is a complete series. A fairly common variety.

(3) Similar to the last, with, in addition, black spots in some of the interspaces ventrally. It is a fairly common variety. I have seen three specimens in the Colombo Museum. In No. 113 both the vertebral and ventral spots form a complete series. Two out of the three specimens in the Madras Museum were of this variety, but neither the vertebral nor ventral series were complete.

(4) With bands nearly as broad or broader than the light interspaces, more or less connected, especially anteriorly, by a ventral stripe. Very analogous to variety A (1) of *cyanocincta*. Rather uncommon.

B.—An intermediate form between A and C, has complete bands anteriorly and dorsal bars posteriorly. It may be compared to variety A (3) of *cyanocincta*. It is a rare form, a good example of which is in the British Museum, presented by Dr. Henderson from Madras.

C.—With dorsal bars throughout and no intermediate vertebral spots. It may be compared to variety D of *cyanocincta*. It is a rare form, of which I have seen examples from Karachi and Bombay. With this I would place the *temporalis* of Blanford.

Habits.—It is a strong and active swimmer, and from its size might prove to be a very disagreeable foe to encounter in the water. Evans and I had one from Moungmya about fifty miles up the river.

Food.—It feeds on fish that have an elongate eel-like conformation. Those I have found in the stomach appeared to be the same as those submitted by me to Dr. J. R. Henderson extracted from the stomachs of *gracilis*. These were pronounced murænids of the genus *Ophichthys*, either *boro* or *orientalis* (McClelland).

Breeding.—(*a*) *The Sexes:* Males appear to be more numerous than females. In the two broods mentioned below, where the young could be sexed, there were fifteen males to six females. I have examined the fœtuses of three broods critically and find there is no disparity in the length of the sexes before birth. In the females the costals are consistently slightly more numerous than in the males, and the ventrals are usually more numerous than in males. The median tubercles on the scales are rather more pronounced in males even before birth.

The genitalia of the males are subcylindrical organs, slightly increasing in girth distally. They are studded with minute, closely-set villous processes in the fœtus all directed towards

the base of the organ. A median raphé passes up the back, and bifurcates just at the tip, each limb surrounding a small blunt little lobule, somewhat triangular in form.

(*b*) *Method of Reproduction :* It is viviparous in habit.

(*c*) *Season :* A gravid female obtained by me in Colombo on January 24, 1920, contained embryos varying from 342 to 367 mm. ($13\frac{1}{2}$ to $14\frac{1}{2}$ inches). The male genitalia were still exserted. These would probably have been born in February, Dr. Henderson acquired a gravid female in Madras on June 1, 1910. The embryos varied from 267 to 292 mm. ($10\frac{1}{2}$ to $11\frac{1}{2}$ inches), and it is quite likely these would not have been born till August. Another gravid female killed in Madras on June 10, 1911, held embryos varying from 393 to 410 mm. ($15\frac{1}{2}$ to $16\frac{1}{4}$ inches). The male genitalia were not exserted. These would have been born very shortly, probably in June.

(*d*) *The Brood :* A Madras specimen contained five embryos that could not be sexed. My Colombo specimen held seven fœtuses, two females and five males. Dr. Henderson's dam contained fourteen young, ten of which were males and four females.

Growth.—(*a*) *The Young :* There are no records of exact measurements at birth, but the fact that I found unborn young with no genitalia visible that measured 393 to 410 mm. ($15\frac{1}{2}$ to $16\frac{1}{4}$ inches) makes it probable that the young are about 405 mm. (16 inches) long when born. Four specimens in the British Museum presented by Sir J. McGrigor are probably fœtuses. They measure from 380 to 403 mm. (15 to 16 inches). It seems unlikely that all these should have been captured after birth, and there is no history to throw any light on the subject. They are labelled from the "Indian Ocean."

(*b*) *Early Life :* I am unable from my records to follow the growth.

(*c*) *Maturity:* The three dams known to me measured 1,550, 1,727, and 2,516 mm., respectively (5 feet 1 inch, 5 feet 8 inches, and 8 feet 3 inches).

(*d*) *Maximum Length:* Most adults range between 1,370 and 1,675 mm. (4½ to 5½ feet). Two specimens of *robusta* in the British Museum are reported by Gunther to be 1,830 mm. (6 feet) long. Specimens over 1,830 mm. (6 feet) are unusual. The measurements of Dr. Henderson's giant specimen are exceeded by a specimen which, with an element of doubt, I refer to this species, killed by Mr. Stone, the first Officer on the P. & O. "Arcadia," off Penang (Bombay Nat. Hist. Journal, Vol. XXII., p. 403). This measured in life 2,745 mm. (9 feet). The dried skin submitted to me for examination measured 2,675 mm. (8 feet 9 inches). Such a specimen may well have been the foundation of the story of "the seasnake."

Poison.—Nothing is known of the toxicity of this venom. No human casualties have been reported, and the poison has not been investigated in the laboratory.

Lepidosis.—(*a*) *Typical—Rostral:* Broader than deep; the portion visible above half to two-thirds the suture between the nasals. *Nasals:* A suture usually from the nostril to the 2nd supralabial. *Præfrontals:* Touch the 2nd supralabials. *Frontal:* Entire; longer than broad; the fronto-parietal sutures subequal to or rather longer than the fronto-supraoculars. *Supraoculars:* Length two-thirds to three-fourths the frontal; breadth two-thirds to three-fourths the frontal. *Parietals:* Entire. *Præoculars:* One. *Postoculars:* One. *Temporals:* One anterior, usually confluent with the subjacent supralabial and so reaching the border of the lip; frequently succeeded by one of nearly equal size. *Supralabials:* Seven to eight; the anterior four, five, or six, entire; the rest small. The 1st and 2nd touch the nasals; 3rd and 4th the eye. *Sublinguals:* Two well-developed pairs, the fellows of each in contact. *Infralabials:* Four; the suture between the first shorter than that between the anterior sublinguals; 4th largest and in contact with three or four

scales behind. *Cuneate:* One between the third and fourth infralabials. (Fig. 68.)

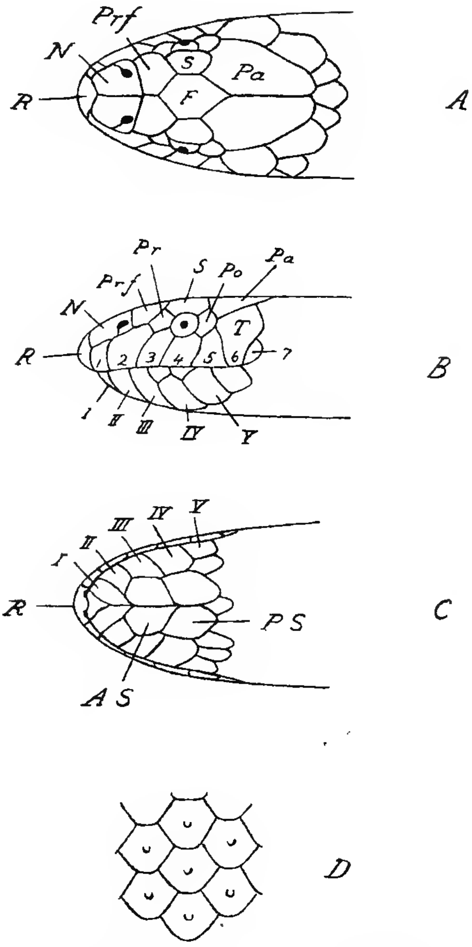

FIG. 68.—Lioselasma spiralis. (Life size.)
D. Costals.

Costals: Longer than broad and imbricate in the anterior cylindrical part of the body; about as broad as long and imbricate or subimbricate on the compressed posterior part.

With a round central tubercle, which is visible in both sexes before birth, if viewed under a lens. In from 27 to 31 rows two heads-lengths behind the head (25 in my type of *alcocki*); 30 to 36 in midbody; 27 to 36 two heads-lengths before the vent. (Posteriorly they are two or three more or less than in midbody, and two to six more than anteriorly.) *Ventrals:* 282 to 373 (282 in my type of *alcocki*), entire throughout; nearly twice the breadth of the last costal rows.

(*b*) *Anomalies—Præfrontals:* Sometimes fail to meet the 2nd supralabial. *Postoculars:* Sometimes two. *Temporals:* The anterior is sometimes broken up into two. The posterior is more frequently not well developed, but replaced by small scales. *Supralabials:* Rarely six; sometimes the fifth, as well as the third and fourth, touches the eye. Sometimes the sixth labial is distinct from the anterior temporal. *Sublinguals:* The posterior pair sometimes separated by a single scale. *Cuneate:* Sometimes two after the third infralabial.

Costals: Rarely juxtaposed posteriorly.

Dentition.—From four skulls in my collection. *Maxillary:* Postnodal,* 6 to 7; scaphiodont; grooved on their antero-external faces. *Palatine:* 6 to 7; anododont, isodont; no edentulous space posteriorly. *Pterygoid:* 12 to 14; anododont, feebly scaphiodont; posterior two-fifths edentulous. *Mandibular:* 13 to 16; anododont, scaphiodont; very feebly grooved on their antero-external faces.

Distribution.—(*a*) *General:* Persian Gulf to Tenasserim (Malay Archipelago, Boulenger).

(*b*) *Local:* It is fairly abundant in the Persian Gulf and along the coast to Karachi. It is apparently uncommon on the Malabar Coast, the only records I can find being one in the British Museum presented by Beddome, and one in the Bombay collection from Bombay. I have seen at least eight specimens from Ceylon. On the Coromandel Coast it is common. I obtained nine examples out of 192 seasnakes from Madras in 1917, and there are many in the Indian Museum from this coast up to Puri. It is seemingly rather uncommon on the Burmese Coast. Evans and I got two from Pegu and Moungmya, and there is one in the Indian

* I have examined these in well over a dozen examples.

Museum from Mergui. There is one in the British Museum from Penang collected by Cantor.

LIOSELASMA CYANOCINCTA (Daudin).

(Greek "kuanos" dark blue, and Latin "cinctus" a girdle.)

The Chittul.

(?) *Bengali :* "chittul" (Russell).

Synonymy.—*Hydrophis tuberculata, H. dayanus, H. subannulata, H. aspera, H. crassicollis, H. trachyceps, H. phipsoni, H. westermanni, H. doliata, H. frontalis, H. sublævis, H. taprobanica, Hydrus, straitus. H. cyanocinctus, Enhydris striatus, E. cyanocinctus, Leioselasma striata, D. tuberculata, D. lapemidoides, D. mamillaris, Chitulia fasciata.*

History.—Figured by Russell in Plate IX. of his second volume (1801), and a specimen in the British Museum collected by him is, I believe, the type. Christened by Daudin in 1803.

General Characters.—A fine species attaining to 6 or 7 feet. Head moderately broad, slightly depressed. Snout rather long, slightly projecting, broadly rounded terminally. Eye small. Commissure of mouth turned up behind. Neck not or hardly apparent. Body cylindrical and of moderate girth in the anterior two-fifths; robust and compressed in the posterior three-fifths; the extreme depth being three times or less than three times the depth of the anterior part of the body.

Identification.—Attention must be directed to many features. The costals are in 27 to 36 rows two heads-lengths behind the head; 38 to 49 at the greatest girth, with bidentate keels. The ventrals 296 to 398. Most specimens will be known by the 3rd, 4th, and 5th supralabials touching the eye; but this character is not constant. Again, there is usually a complete series of cuneate scales behind the 2nd infralabial.

Colouration.—In young the head is black, with a more or less distinct yellow horseshoe mark on the crown; but with advancing age the black fades, and ultimately the head becomes pale olivaceous. The body is olivaceous dorsally,

merging to yellow ventrally, and is variously adorned with from 41 to 70 black bands or bars, which expand vertebrally The various colour varieties may be grouped as follows :—

A.—With well-defined black bands more or less connected ventrally. Analogous to variety A (4) of *spiralis.*
(1) All the bands complete. A common form ranging from the Persian Gulf to Tenasserim.
(2) Some of the posterior bands interrupted costally or subcostally. Not uncommon from the Persian Gulf to Tenasserim.
(3) Some of the posterior bands deficient ventrally and converted into bars. Analogous to variety B of *spiralis.*

B.—With well-defined black bands not united ventrally. Analogous to variety *brugmansi* of *spiralis.* A com mon form from the Persian Gulf to Tenasserim.

C.—With obscure bands or bars. Usually seen in old adults. A common form from the Persian Gulf to Tenasserim.

D.—With well-defined dorsal bars throughout. Comparable to variety C of *spiralis.* Common from the Persian Gulf to Tenasserim.

E.—*phipsoni* (Murray). With a continuous black dorsal band. Comparable to varieties *inornata* of *ornata* and *jayakari* of *viperina.* Known from a single specimen from Bombay, viz., the type in the British Museum.

Habits.—An illustration of its prehensile powers came to my notice in 1916, when a lascar on the Hospital ship "Madras" was heaving the lead at the head of the Persian Gulf. The lascar was much dismayed on landing the lead on deck to find a chittul had wreathed itself round it. The specimen was killed and given to me.

Food.—The diet has not been specially investigated.

Breeding.—(*a*) *The Sexes :* There is nothing special to remark upon. They seem to be evenly balanced and to acquire similar lengths. In the male the keels are rougher and more deeply dentated. The male clasper is beset with recurved processes and is bifid only at the extreme tip.

(*b*) *Method of Reproduction :* It is known to be viviparous.

(*c*) *Season:* No dates are available for the Indian gravid specimens I have examined.

(*d*) *The Brood:* The three prospective mothers investigated by me contained three, eight, and nine embryos, respectively. Another specimen recorded by Fayrer contained sixteen young.

Growth.—(*a*) *The Young:* I have extracted unborn embryos varying from 356 to 381 mm. (14 to 15 inches in length) from one mother which appeared to be on the eve of birth.

(*b*) *Early Life:* I have omitted in my notes to record lengths, and the large material that has passed through my hands yields no recorded notes that will allow me to make any inductions.

(*c*) *Maturity:* The smallest Indian pregnant specimen I have investigated was 889 mm. (2 feet 11 inches).

(*d*) *Maximum Length:* Average adults range between about 1,220 and 1,525 mm. (4 and 5 feet). The largest example in the British Museum is 1,474 mm. (4 feet 10 inches). I have seen one in the Colombo Museum, 1,790 mm. (5 feet 10½ inches). Murray says it grows to 2,135 mm. (7 feet).

Poison.—Russell caused his specimen, which was 1,525 mm. (5 feet) long, to bite a fowl, with the result that death ensued in eight minutes. No casualties are on record, and the poison has not been submitted to laboratory tests.

Lepidosis.—(*a*) *Typical—Rostral:* Broader than high; the portion visible above half to two-thirds the suture between the nasals. *Nasals:* A suture usually passes from the nostril to the 2nd supralabial. *Præfrontals:* Touch the 2nd supralabials. *Frontal:* Entire; longer than broad; the fronto-parietal sutures longer than the fronto-supraoculars. *Supraoculars:* Length two-thirds to three-fourths the frontal; breadth two-thirds to three-fourths the frontal. *Parietals:* Entire; touching the upper postoculars. *Præoculars:* One. *Postoculars:* Two. *Temporals:* Two small scales superimposed anteriorly. *Supralabials:* Seven or eight; very variable; the first four or five usually large, the rest small, all from the third backwards are very prone to division; 1st and 2nd touching the nasals; 3rd, 4th, and 5th the eye. *Sublinguals:* Two pairs; the fellows of both in contact with one another. *Infralabials:* Five; 3rd and 4th subequal and

largest; the suture between the 1st shorter than that between the anterior sublinguals; the 5th touching three or four scales behind. *Cuneate:* A complete series behind the second infralabial. (Fig. 69.)

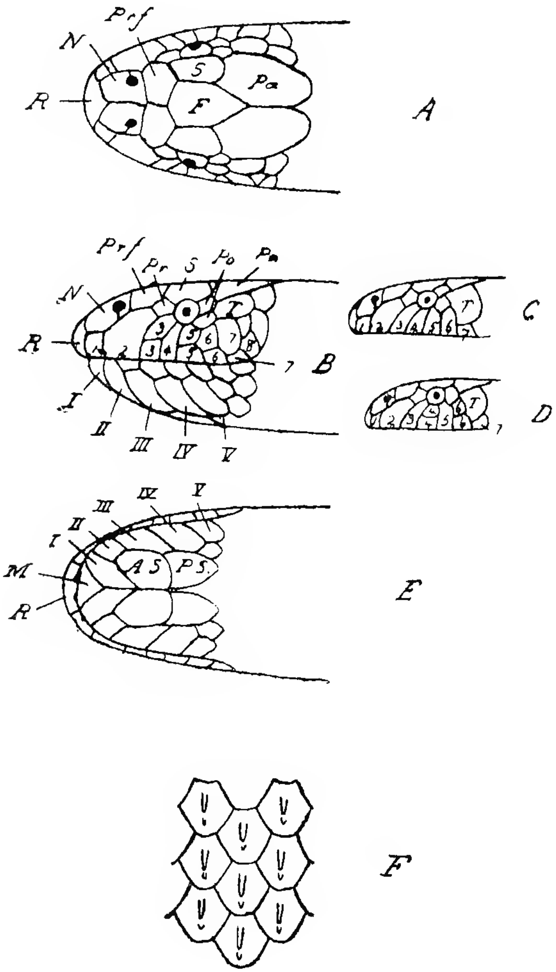

FIG. 69.—Lioselasma cyanocincta.
(Life size.)

Costals : Longer than broad and imbricate on the anterior part of the body ; about as broad as long, imbricate, subimbricate, or juxtaposed on the posterior compressed part ; with short, unequally bi- or tri-dentate keels occupying about the median third of each scale ; the posterior tooth smaller than the anterior. In 27 to 36 rows two heads-lengths behind the head ; 33 to 44 in midbody ; and 34 to 43 two heads-lengths before the vent. *Ventrals :* 296 to 398 (281 to 385, Boulenger) ; entire throughout ; nearly twice as broad as the last costals.

(*b*) *Anomalies—Nasals :* Rarely sutures from the nostril detach a fragment which forms a pseudo-loreal. *Præfrontals :* Rarely these fail to meet the 2nd supralabials. I have no record of this deviation bilaterally. *Præoculars :* A divided third supralabial creates a pseudo lower præocular occasionally. *Postoculars :* Rarely one ; a divided 4th or 5th supralabial creates a pseudo third postocular. *Temporals :* Sometimes there is a large anterior shield ; a divided 6th supralabial may create a pseudo third anterior temporal. *Supralabials :* Subject to much variation. Sometimes only the 3rd and 4th touch the eye, or the 3rd and 5th, the 4th being represented by a cuneate shield. A confluence of parts of the 3rd, 4th, and 5th again leads to many anomalies. *Sublinguals :* Sometimes the fellows of the posterior pair are completely separated by a scale. *Cuneate :* Rarely the series begins after the 3rd infralabial, and more rarely only one shield occurs between the 3rd and 4th infralabials.

Costals : The keels are sometimes in places tridentate.

Dentition.—From three skulls in my collection from Baluchistan and Madras. *Maxillary :* Postnodal, 6 to 10.* *Palatine :* 7 to 9. *Pterygoid :* 15 to 19. *Mandibular :* 16 to 17.

Distribution.—(*a*) *General :* From the Persian Gulf to China, Japan, and Papuasia.

(*b*) *Local :* It is probably the commonest seasnake from the Persian Gulf to Baluchistan. It is one of the commonest hydrophids on both the Malabar and Coromandel Coasts of

* I have examined these in over twenty specimens.

India. I saw four good examples in the Colombo Museum, of Ceylon origin. It is apparently a rare snake on the Burmese Coast. Evans and I failed to get a specimen, and there was no example in the Indian Museum from this locality when I examined the collection in 1914. There appears to be no record from the Andamans. One specimen in the British Museum is from Mergui.

I have dealt herein with the species as I know it from Indian Coasts exclusively; purposely avoiding all reference to several species that have been described by various authors from waters east of Tenasserim, which I showed in my Monograph were not, in my opinion, entitled to rank as species distinct from *cyanocincta*.

Lioselasma lapemidoides (Gray).

This species recognized as such by Boulenger, I cannot dissociate from *cyanocincta* (Daudin). The only important difference I can discover in Boulenger's descriptions of the two is that the scales in *cyanocincta* are imbricate posteriorly, whilst those in *lapemidoides* are juxtaposed. In at least one other hydrophid, viz., *fasciata* (Schneider), Boulenger himself recognizes that the scales posteriorly are imbricate, subimbricate, or juxtaposed. I have examined all the specimens labelled *cyanocincta* and *lapemidoides* in the British Museum side by side, and cannot separate them. I have entered in my notebook, against Lort Phillips's specimen in the British Museum labelled *cyanocincta*, the remark "scales almost juxtaposed." I append, however, Boulenger's own description of *lapemidoides*.

"Head rather small; body elongate, slender anteriorly, diameter of the neck two-fifths to one-third the greatest depth. Rostral slightly broader than deep; nasals shorter than the frontal, more than twice as long as the suture between the præfrontals; frontal much longer than broad, as long as or a little shorter than its distance from the end of the snout, shorter than the parietals; one præ- and two or three postoculars; eight upper labials, second largest, third and fourth

entering the eye; two or three superimposed anterior temporals; two pairs of subequal chin shields in contact, or posterior separated by one scale. 30 to 33* scales round the neck, 43 to 47† round the body; scales rhomboidal and subimbricate on the neck, hexagonal and juxtaposed on the body; of young smooth, of adult female with a feeble tubercle or keel, of adult male with a strong spinose tubercle. Ventrals distinct throughout, 300 to 387. Young yellowish or grayish olive above, white beneath, with complete black rings which are broadest on the back; head black, with an angular yellow (vermilion) band above the apex on the snout; tail black, with light vertical bands at the base. In the adult the bands become more obsolete and are not continued across the body, and the head is uniform olive brown.

"Total length 940 mm., tail 90.

"Coasts of Baluchistan, India, and Ceylon."

Four of these specimens are from Ceylon, one from Madras, one from Orissa, and one from Gwadar, Baluchistan.

LIOSELASMA BITUBERCULATA (Peters).

(Latin "bis" twice, and "tuberculatus" with a boss, referring to the tubercles on the scales.)

Peters' Seasnake.

Known from a single specimen described by Peters in 1872, which is deposited in the Berlin Museum. It appears to be very closely allied to *cyanocincta* (Daudin).

General Characters.—A snake of fair proportions growing to over 3 feet. Head and general habit seemingly very like *cyanocincta*.

Identification.—Will be recognized by the following features: The bidentate keels on the scales, the costal rows two heads-lengths behind the head 28, and in midbody 47.

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* I count these in the same specimens two heads-lengths behind the head 31 to 37.

† I count them 40 to 49.

Growth.—The length is reported to be 1,000 mm. (3 feet 3½ inches).

Lepidosis.—*Rostral :* The portion visible above two-thirds the suture between the nasals. *Nasals :* A single suture from the nostril to the 2nd supralabials. *Præfrontals :* Touching the 2nd supralabials. *Frontal :* Entire; longer than broad; the fronto-parietal sutures rather longer than the fronto-supra-oculars. *Supraoculars :* Length four-fifths the frontal; breadth two-thirds the frontal. *Parietals :* Entire; touching the upper postoculars. *Præocular :* One. *Postoculars :* Two. *Temporals :* One large anterior, succeeded by a subequal posterior. *Supralabials :* Seven; the first five large; 1st and 2nd touching the nasals; 3rd and 4th the eye. *Sublinguals :* Two well-developed pairs, the posterior separated by one scale. *Infralabials :* Four; the suture between the first as long as that between the anterior sublinguals; 4th largest, and touching three or four scales behind. *Cuneate :* One between the 3rd and 4th infralabials.

Costals : Longer than broad and imbricate anteriorly; subimbricate or juxtaposed posteriorly; with short, median, bidentate keels. In 28 rows two heads-lengths behind the head, and 47 in midbody (I was informed by Herr Tornier, the Superintendent of the Zoological Museum, Berlin, in 1907). *Ventrals :* 278; nearly twice the breadth of the last costal rows.

Distribution.—Colombo, Ceylon.

Genus CHITULIA.

(Latinized form of the vernacular name "chittul.")

General Characters.—Length moderate. Habit robust. Body moderately attenuated anteriorly, the diameter being about half to three-fifths that of the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals :* Sutured to præfrontals and frontal; longer than frontal. *Præfrontals :* Meeting parietals and postfrontals. *Frontal :* As broad as long; not (?) meeting postfrontal at rim of orbit. *Parietal :* Not keeled inferiorly. *Quadrate :* Oblique from above backwards; extreme length superiorly four-fifths its depth.

Maxilla : Not extending beyond palatine anteriorly ; extending beyond palatine posteriorly.

Dentition.—From one skull in my collection. *Maxillary :* Postnodal, 9 to 11 ;* feebly scaphiodont. *Palatine :* 8 ; anododont, isodont; no edentulous space posteriorly. *Pterygoid :* 21 to 22 ; anododont, feebly scaphiodont ; posterior third edentulous. *Mandibular :* 18 to 20 ; anododont, scaphiodont.

There is one species, viz., *ornata.*

Chitulia ornata (Gray).

(Latin " ornata " adorned.)

Gray's Seasnake.

Synonymy.—*Aturia ornata, Chitulia inornata, Hydrophis ocellata, H. striatus, H. schlegeli, H. lævis, H. ellioti, Thalassophis schlegelii, Distira ornata, D. andamanica.*

History.—First described and christened by Gray in 1842, from a young specimen which is the type, and preserved in the British Museum.

General Characters.—A species of respectable proportions and robust habit growing to about 4 feet. Head moderately elongate, slightly depressed. Snout moderately long, declivous, obtusely rounded terminally. Eye moderate. Commissure of mouth turned up posteriorly. Neck slightly if at all apparent. Body anteriorly cylindrical and robust ; posteriorly compressed and rather heavy ; the extreme depth being twice or less than twice the depth anteriorly.

Identification.—The following syndrome will determine its identity: Scale rows 33 to 41 two heads-lengths behind the head, 38 to 46 at the extreme girth ; ventrals 218 to 290 ; the eccentric tubercle ; and the absence of any cuneate shield.

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* I have examined these in many specimens.

Colouration.—The head is dark olivaceous, uniform or with some obscure yellowish mottling. The body, which is dorsally dark olivaceous, merging to whitish ventrally, is adorned with from 41 to 45 black bars or bands, the arrangement of which is variable. The various colour varieties may be grouped as follows :—

A.—With complete bands which taper ventrally, and may be incomplete ventrally in the posterior part of the body. It is comparable to varieties A of *viperina*, *spiralis*, and *cyanocincta*. Apparently rare. I have seen a specimen from Karwar.

B.—*typica* (Gray). With dorsal bars, which are discrete and broader than the intervals. Analogous to varieties C of *viperina* and *spiralis*, and D of *cyanocincta*. The usual Indian form. Three of the four specimens in the Colombo Museum are of this variety.

C.—Like the last, only the bars are modified into rhombs, the angles of which are confluent or nearly so vertebrally. Uncommon.

D.—Like *typica*, but with lateral bars or large spots alternating with the dorsal bars. Not very uncommon. A specimen in the British Museum from Madras was presented by Jerdon. I examined a Ceylon example in the Colombo Museum, and there is a good specimen in the Indian Museum from the Burmese coast, presented by Captain Lloyd.

E.—*inornata* (Gray). With a continuous, broad, black, dorsal stripe as though the bars of *typica* were completely confluent. This stripe is sharply-defined above midcosta. It is exactly analogous to varieties *jayakari* of *viperina*, and *phipsoni* of *cyanocincta*. Uncommon. Gray's type is from the Indian Ocean, and another in the British Museum presented by Kempe is labelled "India."

Habits.—There is nothing special to remark.

Food.—No observations have been made on the species of fish forming its special diet.

Breeding.—(*a*) *The Sexes :* I have observed no peculiarities distinctive of either sex.

(*b*) *Method of Reproduction :* Presumably viviparous like other hydrophids, but there is no definite evidence to support this view.

(*c*) *Season :* A juvenile specimen captured in Madras on June 29 appeared to be very recently born.

(*d*) *Period of Gestation :* Not known.

Growth.—(*a*) *The Young :* No gravid female has been recorded. The smallest specimen I know of, which appeared to be very recently born, was 375 mm. (1 foot $2\frac{3}{4}$ inches) in length.

(*b*) *Maximum Length :* The largest specimen I know is that recorded by Gunther for *H. ellioti*, viz., 1,245 mm. (4 feet 1 inch).

Poison.—Nothing known. No casualties have been recorded, and the poison has not been submitted to laboratory tests.

Lepidosis.—The shielding of the head is subject to unusual variation, and the ranges of the costals and ventrals are considerable.

(*a*) *Typical—Rostral :* Rather broader than deep; the portion visible above from half to three-fifths the length of the suture between the nasals. *Nasals :* A suture from the nostril passes to the 2nd supralabial. *Præfrontals :* Touch the 2nd supralabials. *Frontal :* Entire; rather longer than broad; the fronto-parietal sutures rather longer than the fronto-supraoculars. *Supraoculars :* Length three-fourths to four-fifths the frontal; breadth two-thirds to three-quarters the frontal. *Parietals :* Entire; touching the upper postoculars. *Præoculars :* One. *Postoculars :* Two. *Temporals :* Very variable; usually not differentiated, but replaced by two or three superimposed scales anteriorly. *Supralabials :* Seven or eight; the first three are usually entire, but any or all of the rest may be divided; the 1st and 2nd touch the nasals, and the 3rd and 4th the eye. *Sublinguals :* Two well-developed pairs; the posterior fellows separated, or the posterior pair not differentiated. *Infralabials :* Four or five; the suture between the first shorter than that between the

anterior sublinguals ; fourth or fifth largest and in contact with three or four scales behind. *Cuneate :* None. (Fig. 70.)

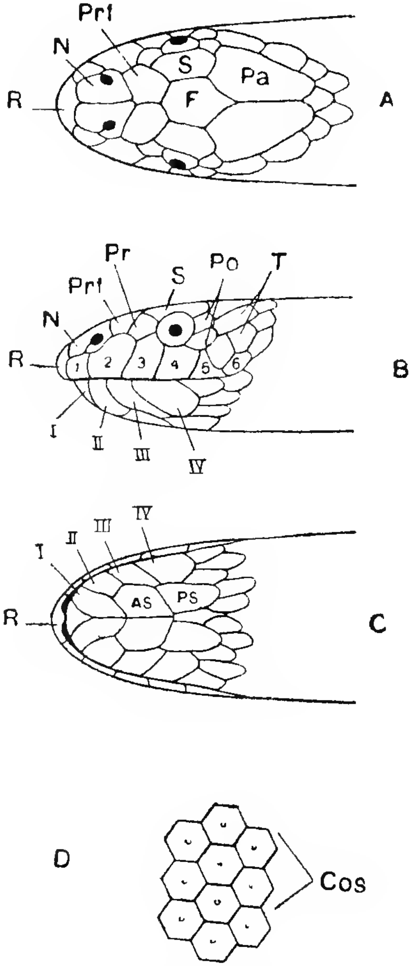

FIG. 70.—Chitulia ornata.
(× 1½.)
D. Costals.

Costals : Longer than broad and feebly imbricate anteriorly, about as broad as long, hexagonal, feebly imbricate or juxtaposed on the compressed posterior part ; with a small, round, slightly eccentric tubercle placed post-centrally. In 33 to 41 rows two heads-lengths behind the head ; 38 to 45 in midbody ; and 33 to 42 two heads-lengths before the vent. *Ventrals :* 218 to 290 ; entire, or a few divided posteriorly ; nearly twice the breadth of the last costal rows. *Anal :* Variable.

(*b*) *Anomalies.—Nasals :* The suture from the nostril rarely passes to the 1st supralabial. *Præfrontals :* It is not very unusual for these not to meet the 2nd supralabial on one side, but this deviation is decidedly rare bilaterally. A detached fragment rarely forms a pseudo-loreal. *Postoculars :* The upper part of the 5th or 6th supralabials may be considered a third postocular by some authors. *Supralabials :* The 3rd, 4th, and 5th rarely touch the eye. *Cuneate :* One is rarely interpolated between the 3rd and 4th infralabials.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* Coasts from the Persian Gulf to the Malay Peninsula. (New Guinea and Australia, Boulenger).

(*b*) *Local :* Throughout the range given by me above it is an uncommon species.

There is one from Muscat in the British Museum, and I have seen another from the Persian Gulf caught at Jask. It is not mentioned by Murray from the Sind Coast. A specimen in the Bombay Natural History Society's collection is from Karwar. Ferguson mentions two in the Trivandrum Museum from Travancore, and presented another to the British Museum from that coast. Another from the Travancore Coast is preserved in the Indian Museum, Calcutta. I found four good specimens in the Colombo Museum from the Ceylon coasts. I acquired one from Madras out of 192 seasnakes in 1917, and the British Museum has one from the same locality. Further north it does not appear to have been captured. I failed to get one from the Burmese Coasts, but there is one in the Indian Museum from Sandaway. The type of Annandale's

andamanica was from the Andamans. It has been recorded from Siam, and the Skeat Expedition obtained specimens from the Patani Coast of the Malay Peninsula.*

Genus POLYODONTOGNATHUS Gen. nov.

(Greek "poly" many, "odous" tooth, "gnathos" jaw.)

General Characters.—Length small. Body moderately attenuated anteriorly, the diameter about half to one-third the extreme depth posteriorly.

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* A very closely allied form, described by Peters under the name *godeffroyi* is known from seas to the east of Malaya, *i.e.*, the Chinese sea, the neighbourhood of the Philippines, and the Loo Choo Islands. Both Boulenger and Stejneger recognized the form as a specific entity. I, on the other hand, cannot dissociate this form from Gray's *ornata*. So far as this work is concerned the point is of no material importance, for my conception of *ornata* as herein presented is confined entirely to sixteen specimens from seas between the Persian Gulf and Siam, which I recognize as *ornata*. I have eliminated three specimens recognized as *ornata* by Boulenger, viz., the type from the Indian Ocean, and the type and another of *inornata* (Gray), also labelled "Indian Ocean." as they may not have been collected from Indian Coasts.

As a matter of interest, however, I contrast some points of major importance affecting the Indian series of sixteen *ornata* with sixteen others from Eastern seas that have claim to be considered *godeffroyi*. Two of these in the British Museum are labelled *godeffroyi* by Boulenger, four others are referred to by Stejneger as *godeffroyi* (Herp. Japan, 1907, p. 434) from the Loo Choos, and nine others examined by me in Mr. Owston's Loo Choo Islands collections and referred by me to *ornata*, as well as one in the Royal College of Surgeons' Museum (No. 517) from Manilla.

Indian *ornata*.	Loo Choo and Philippine *godeffroyi*.
(1) Costal rows two heads-lengths behind head : 33 to 41.	(1) Costal rows neck : 30 to 36.
(2) Costals midbody : 38 to 46.	(2) Costals body : 33 to 43.
(3) Ventrals : 218 to 290.	(3) Ventrals : 227 to 271.
(4) Dorsal bars : 35 to 41.	(4) Dorsal bars : 30 to 49.

The lepidosis of the head is admitted by both contending parties to be subject to variation. I cannot find any characters, with even fair constancy, that will permit of a distinction between the Indian *ornata* and the Far Eastern *godeffroyi*. The differences (?) in the lepidosis of the body of the two forms as shown above is very unconvincing. I think that in both areas of distribution the accumulation of a larger material will steadily reduce the slight differences now apparent.

Cranial Osteological Characters.—*Nasals:* Sutured to præfrontals and frontal; longer than frontal. *Præfrontals:* Meeting parietal and postfrontals. *Frontal:* Breadth three-fourths the length; not meeting postfrontal at rim of orbit. *Parietal:* Not keeled inferiorly. *Quadrate:* Oblique from above backwards; extreme length superiorly half its depth. *Maxilla:* Not extending beyond palatine anteriorly; extending beyond palatine posteriorly.

Dentition.—From three skulls in my collection. *Maxillary:* Postnodal, 13 to 17;* isodont. *Palatine:* 7 to 8; anododont, isodont; no edentulous space posteriorly. *Pterygoid:* 19 to 25; anododont, feebly scaphiodont; posterior half edentulous. *Mandibular:* 22 to 26; anododont, isodont.

There is one species, viz., *cærulescens.*

POLYODONTOGNATHUS CÆRULESCENS (Shaw).

(Latin "cærulesco" I become blue, implying bluish.)

Merrem's Seasnake.

Marathi: "minerrh" and "mathera" of Bombay fishermen.

Synonymy.—*Hydrus cærulescens, Enhydris cœrulescens, Distira cœrulescens, Hydrophis obscurus, H. cyanocincta.*

History.—The type which is in the British Museum was obtained by Dr. Patrick Russell. It received its official baptism in 1802 at the hands of Shaw.

General Characters.—It is a small species growing to about 2½ feet in length. Head small, rather elongate, not depressed. Snout of moderate length, hardly projecting, declivous, obtusely rounded terminally. Eye small. Commissure of mouth slightly turned up posteriorly. Neck not constricted. Body slender and cylindrical in its anterior two-fifths; stoutish and compressed in the posterior three-fifths; the extreme depth being two or three times that of the slender anterior part. The scales are very rough, especially in old males.

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* I have examined these in over twenty specimens.

Identification.—Attention must be directed to many points. The scales have a median short keel in their median third, are in 36 to 45 rows two heads-lengths behind the head, 42 to 53 in the greatest girth; and the ventrals number 277 to 339. In a normal specimen the fact that the parietal shield does not touch the postocular affords an easy method of recognition, as no other seasnake presents the same peculiarity.

Colouration.—The body is bluish or grayish blue dorsally, merging to yellowish ventrally, and is surrounded with from 35 to 58 deep bluish-black bands. These are as broad as or rather broader than the interspaces at midcosta, and are complete in the young, but as age advances they lose definition and become obscure. In many old specimens they are obliterated ventrally, and converted into bars, these being dilated and more or less confluent vertebrally. The head is black, and the young have a yellowish horseshoe shaped mark, which becomes obscured with age.

I have seen an adult specimen that was uniform blackish blue, which must be considered a melanotic example.

Habits.—There is nothing known that deserves special mention.

Food.—No observations have been made regarding its gastronomic tastes.

Breeding.—(*a*) *The Sexes:* There appears to be no disparity in the measurements of the sexes. I have critically examined the ranges of costals and ventrals in the sexes of a large series, and can discover nothing peculiar in either sex. Males are extremely rough from the prominence of their keels. The claspers are not bifid. The secretion of the anal glands is pure white.

(*b*) *Method of Reproduction:* It is viviparous in habit.

(*c*) *Season:* I have examined three prospective mothers, all in early stages of pregnancy, killed in the months of May and June. The most advanced brood measured only 105 to 120 mm. ($4\frac{1}{8}$ to $4\frac{3}{4}$ inches) on June 17, and they would probably not have been born till many weeks later. One killed on June 2 had three very small eggs and a retained sac, containing a withered fœtus about 100 mm. (4 inches) long, the product of the previous year's mating.

(*d*) *Period of Gestation:* Not known.

(*e*) *The Brood:* The five breeding events that have been investigated by me show that the brood numbers from two to six. In one the sex could be established, and included three males and two females.

Growth.—(*a*) *The Young:* I have seen no unborn young sufficiently near their nativity to conjecture their length at birth. I have one record of a juvenile male specimen, killed in Bombay on June 4, 1917, that measured 457 mm. (18 inches).

(*b*) *Maturity:* My smallest pregnant specimen was exactly 610 mm. (2 feet) in length.

(*c*) *Maximum Length:* The longest specimen I have examined was a female and measured 737 mm. (2 feet 5 inches).

Poison.—Nothing known. No casualties are on record, and the poison has not been investigated in the laboratory.

Lepidosis.—The lepidosis of the head is fairly constant, except for the posterior supralabials and the temporal region. The shields in adults are covered with minute asperitics that make them very rough. The ranges of body scales are considerable.

(*a*) *Typical—Rostral:* Broader than deep; the visible portion about one-half the length of the suture between the nasals. *Nasals:* Sutures from the nostril, when present, pass backwards to the præfrontals, and outwards to the 2nd supralabial. *Præfrontals:* Touch the 2nd supralabial. *Frontal:* Entire; longer than broad; the fronto-parietal sutures longer than the fronto-supraoculars. *Supraoculars:* Length about three-fourths to three-fifths the frontal, breadth about three-fourths the frontal. *Parietals:* Entire; not touching the upper postoculars. *Præoculars:* One. *Postoculars:* One. *Temporals:* Small and most irregular, not deserving the name. Usually three or four superimposed scales anteriorly. *Supralabials:* Seven or eight; the anterior four or five entire, rest small and subject to division. The 1st and 2nd touch the nasals, 3rd and 4th the eye. *Sublinguals:* Variable; sometimes two well-developed pairs, often no well-developed pair; the posterior, when present, usually separated by small scales. *Infralabials:* Four; the suture between the first shorter than that between the anterior sublinguals when

these are developed ; 4th largest and touching three or four scales behind. *Cuneate:* One between the 3rd and 4th infralabials. (Fig. 71.)

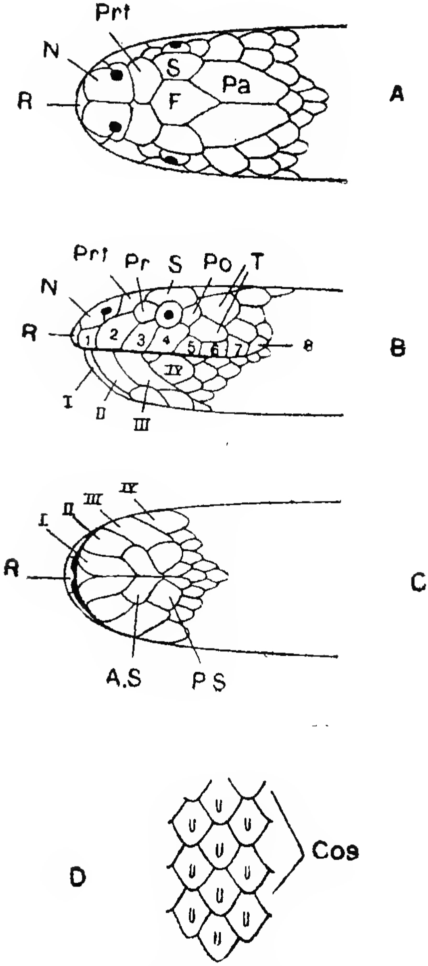

FIG. 71.—Polyodontognathus cærulescens.
(× 2.)
D. Costals.

Costals : Longer than broad and imbricate or subimbricate on the slender anterior part of the body ; about or nearly as broad as long, and subimbricate or juxtaposed on the compressed posterior part, with a short pronounced keel that occupies about the median third of each scale. In 36 to 45 rows two heads-lengths behind the head ; 42 to 53 in midbody ; and 36 to 46 two heads-lengths before the vent. *Ventrals :* 277 to 339 ; entire throughout, and about or nearly twice the breadth of the last costal row. For a seasnake the range of ventrals is notably small. *Anal :* Variable.

(*b*) *Anomalies—Frontal :* Rarely divided longitudinally. *Parietals :* Rarely more or less disintegrate ; rarely touch the upper postoculars. *Postoculars :* Rarely two. *Temporals :* Sometimes a fairly well-developed anterior shield. *Supralabials :* Rarely six. I have seen the 1st divided in one example ; and the 3rd, 4th, and 5th touching the eye on one side in one specimen. *Cuneate :* Sometimes two or more after the 3rd infralabial.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* Coasts between Bombay and Penang.

(*b*) *Local :* It is an extremely common snake in the locality of Bombay, and it is curious to note that north and south it is extremely rare. Murray does not mention it from the Sind Coast, and there was no specimen in the Quetta Museum when the collection was submitted to me for identification. I failed to get it in Cannanore, there is no specimen in the Trivandrum Museum, and I can find no records from the Malabar Coast, other than the neighbourhood of Bombay. It is not represented in the Colombo Museum. Out of 192 seasnakes collected for me in Madras in 1917 no single specimen was included, and I have only seen one from that locality. The type was from Vizagapatam. Further north, especially in the vicinity of the Sunderbunds, it is again quite a common snake. Evans and I failed to obtain a specimen from the coast of Burma, and I can find no record from this coast. Further south about Mergui it is a fairly common snake, as there are many specimens so labelled in the Indian Museum. In the neighbourhood of the Malay Peninsula, where it appears to reach the

limit of its distribution, Cantor obtained a specimen from Penang; Annandale and Robinson several from Patani; and Wray two from Perak.

I have examined well over sixty specimens.

Genus POLYPHOLOPHIS Gen. nov.

(Greek " polus " many, " pholis " scale, " ophis " snake.)

General Characters.—No adult known. Body moderately attenuated anteriorly, diameter about half that of the extreme depth posteriorly.

Cranial Osteological Characters.—Not known.

Dentition.—*Maxillary:* Postnodal, 11 to 12; the counts on both sides somewhat dubious. *Palatine* and *Pterygoid:* Not known. *Mandibular:* 20.

There is one species, viz., *neglectus*, which deserves inclusion in a separate genus on the very numerous costal rows and ventrals.

POLYPHOLOPHIS NEGLECTUS (Wall).

(Latin, meaning neglected.)

Wall's Seasnake.

Synonymy.—*Hydrophis obscurus.*

History.—Known from a single, apparently juvenile, specimen in the Indian Museum (No. 8,598), referred by Sclater to *obscurus* (Daudin), which is so different from any other seasnake known to me that I described it as a new species in 1906.

General Characters.—In general appearance very like *fasciata* (Schneider), but probably most closely related to *cærulescens* (Shaw). Head small, not depressed. Snout moderately long, declivous, slightly projecting, moderately rounded terminally. Eye small. Commissure of mouth turned up behind. Neck not apparent. Body slender and cylindrical in the anterior two-fifths; compressed and robust in the posterior three-fifths; the extreme depth about twice that of the slender anterior part.

Identification.—The costals in 48 rows two heads-lengths behind the head; 56 in the thickest part; and ventrals exceeding 420 will suffice to identify it.

Colouration.—Head and neck quite black. Body surrounded by 59 well-defined blackish annuli, about as broad as the intervals at midcosta, and confluent ventrally in the anterior part.

Habits, Food, Breeding.—Nothing known.

Growth.—I have no record of the measurement, but speaking from memory, it is less than 610 mm. (2 feet) in length.

Poison.—Nothing known.

Lepidosis.—*Rostral:* The portion visible above about half the length of the suture between the nasals. *Nasals:* A suture passes from the nostril to the 2nd supralabial. *Præfrontals:* Touching the 2nd supralabial. *Frontal:* Entire; longer than broad; the fronto-parietal sutures subequal to the fronto-supraoculars. *Supraoculars:* Length about three-fourths the frontal; breadth about three-fourths the frontal. *Parietals:* Entire; touching the postoculars. *Præoculars:* One. *Postoculars:* One. *Temporals:* One large anterior on the left side, two on the right. *Supralabials:* Seven, first five entire; 1st and 2nd touching the nasals, 3rd and 4th the eye. *Sublinguals:* Two pairs, the fellows of each in contact. *Infralabials:* Four; the suture between the first equal to that between the anterior sublinguals; fourth largest and in contact with three scales behind. *Cuneate:* One between the 3rd and 4th infralabials.

Costals: Longer than broad and imbricate on the anterior part of the body; about as broad as long and imbricate on the compressed part, with a short keel occupying about the median three-fifths of each scale. In 48 rows two heads-lengths behind the head; 54 in midbody (56 at the thickest girth); and 45 two heads-lengths before the vent. *Ventrals:* About 440 to 450 (damaged); entire throughout, and nearly twice the breadth of the last costals.

Dentition.—Detailed under the genus.

Distribution.—The type is from Rangoon.

Genus MELANOMYSTAX Gen. nov.

(Greek " melas " black, " mustax " moustache.)

General Characters.—Length moderate. Habit robust. Body moderately attenuated anteriorly, where its calibre is rather more than a third the extreme depth posteriorly.

Cranial Osteological Characters.—Unknown. I have no skull.

Dentition.—*Maxillary :* Postnodal, 1 to 2.* *Palatine* and *Pterygoid :* Not known. *Mandibular :* 14.

There is one species, viz., *nigrocinctus*, which deserves to rank in a genus apart from other hydrophids on the very few postnodal maxillary teeth.

MELANOMYSTAX NIGROCINCTUS (Daudin).

(Latin " niger " black, " cinctus " girdle.)

Daudin's Seasnake.

Bengali : " kerril patte " (Russell).

Synonymy.—*Enhydris nigrocinctus, Distira lapemidoides, D. cyanocinctus, D. hendersoni, Hydrus nigrocinctus.*

History.—Described first by Russell in 1801, a fair coloured representation being shown in Plate VI. of his second volume. Christened by Daudin in 1803. Russell's type is preserved in the British Museum.

General Characters.—A snake of fair proportions growing to 3½ feet. Head moderate, rather broad ; moderately depressed. Snout of moderate length, declivous, hardly projecting, rather broadly rounded terminally. Eye small. Commissure of mouth turned up behind. Neck not apparent. Body cylindrical and of fair girth anteriorly ; much compressed and heavy posteriorly, the extreme depth being about three or rather less than three times that in the anterior part.

Identification.—It is one of the few seasnakes in which the præfrontal does not touch the 2nd supralabial. This taken with 27 to 32 scale rows two heads-lengths behind the head, 36 to 43 imbricate in midbody, and from 311 to 339 ventrals will establish the identity. A distinctive feature in colouration is the curved black moustache.

Colouration.—Olivaceous green dorsally, merging to a clear yellow, often very bright, ventrally. The body is surrounded with from 42 to 62 well-defined black or deep greenish black

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* I have examined these in three specimens.

bands, which are usually narrower than the intervals at midcosta. These bands expand vertebrally, but are not connected ventrally even anteriorly. The head is yellow with an arched black moustache. There is also a black mark, often bifid on the nape and occiput, extending forwards to the præfrontals, which tends to break up into an indefinite mottling in old subjects. There is also a short, vertical, lateral, black neck stripe.

Habits, Food, and Breeding.—Have not been remarked upon.

Growth.—*Maximum Length :* Evans and I got specimens measuring 997 and 1,055 mm. (3 feet 3¼ inches and 3 feet 5½ inches, respectively). Russell's type was 1,017 mm. (3 feet 4 inches).

Poison.—Russell caused a fowl to be bitten by his specimen, the bird succumbing seven minutes later. No casualties have been reported and no experimental work done with the poison.

Lepidosis.—The head shields are subject to an even greater variation than is usual in hydrophids, most of them being prone to division.

(*a*) *Typical—Rostral :* Broader than deep; the portion visible above half to three-fifths the suture between the nasals. *Nasals :* Two sutures usually radiate from the nostril, one to the præfrontals, the other to the 2nd supralabials. *Præfrontals :* Do not touch the 2nd supralabials. *Frontal* ; Entire, longer than broad; the fronto-parietal sutures longest. *Supraoculars :* Length half to two-thirds the frontal; breadth half to two-thirds the frontal. *Parietals :* Entire; touching the upper postoculars. *Præoculars :* One. *Postoculars :* One or two. *Temporals :* Undifferentiated and replaced by small scales, two usually being superimposed anteriorly. *Supralabials :* Seven to nine; all from the first backwards are prone to division, forming pseudo-loreals and pseudo lower præ- and postoculars; 1st and 2nd touching the nasals; 3rd and 4th, or 3rd, 4th, and 5th the eye. *Sublinguals :* Two well-developed pairs, the posterior usually completely separated. *Infralabials :* Four; the suture between the first subequal to that between the anterior sublinguals; 4th

largest and in contact with three or four scales behind. *Cuneate :* One between the 3rd and 4th infralabials. (**Fig. 72.**)

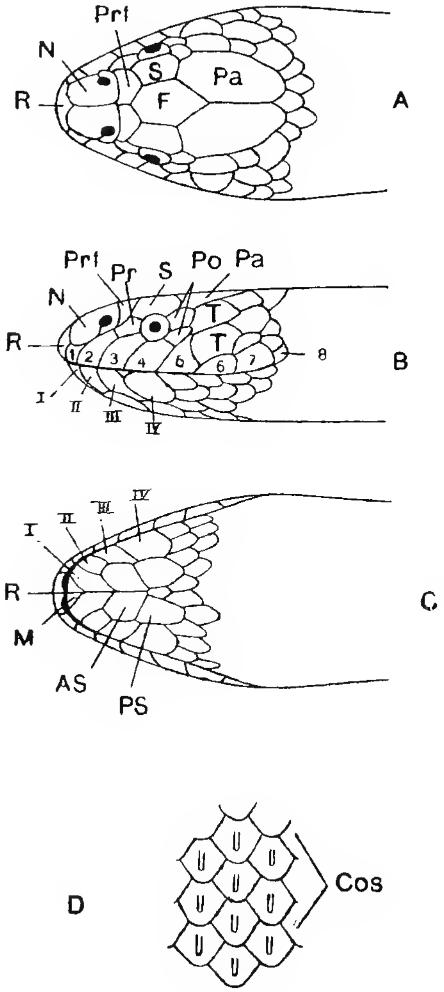

FIG. 72.—Melanomystax nigrocinctus.
(× $1\frac{1}{2}$.)
D. Costals.

Costals : Longer than broad and imbricate on the cylindrical anterior part of the body; as broad or broader than long and imbricate on the posterior compressed part, with a short keel occupying about the median three-fifths of each scale. In 27 to 32 rows two heads-lengths behind the head; 36 to 43 in midbody; and 36 to 42 two heads-lengths before the vent. *Ventrals :* 305 to 339; entire throughout, and nearly twice the breadth of the last costal rows.

(*b*) *Anomalies—Nasals :* Sometimes divided into three parts by three triradiate sutures from the nostril. *Præfrontals :* I have seen them touching the 2nd supralabial on one side in two specimens. *Sublinguals :* The fellows of the posterior pair sometimes in contact. *Cuneate :* Sometimes two after the 3rd infralabials.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* From the Sunderbunds to the Burmese Coast (Straits of Malacca, Boulenger).

(*b*) *Local :* Apparently a rare snake. Russell's type was from the Sunderbunds. Evans and I obtained two in Burma, one at Watiya 40 miles from the sea, and the other from Mayaungmya 50 miles from the sea. Boulenger's type of *hendersoni* is from Rangoon. Three specimens in the Indian Museum No. 8,235, identified by Sclater as H. *dayanus*, and Nos. 8,239 and 8,240 have no recorded habitat.

I have examined nine specimens.

Genus KERILIA.

(Latinized version of the vernacular name "Keril," *Kerilia imbricata.*)

General Characters.—Length moderate. Habit robust. Diameter of body anteriorly about half that of the extreme posterior depth.

Cranial Osteological Characters.—*Nasals :* Sutured to præfrontals and frontal, longer than the frontal. *Præfrontals :* Meeting parietal and postfrontals. *Frontals :* As broad as long, not meeting postfrontal at rim of orbit. *Parietal :* Keeled inferiorly. *Quadrate :* Oblique from above backwards, extreme length superiorly four-fifths its depth. *Maxilla :* Extends beyond the palatine anteriorly and posteriorly.

Dentition.—From three skulls in my collection. *Maxillary :* Postnodal, 7 to 9;* feebly scaphidont. *Palatine :* 8 to 10; anododont, isodont; no edentulous space posteriorly. *Pterygoid :* 12 to 16; anododont, feebly scaphiodont; posterior two-fifths edentulous. *Mandibular :* 17 to 19; anododont, scaphiodont.

There is one species, viz., *jerdoni.*

KERILIA JERDONI (Gray).

(Named in honour of the late Dr. T. C. Jerdon, the distinguished Ornithologist and Naturalist of the Madras Medical Service.)

Jerdon's Seasnake.

(?) *Tamil:* " shiddil " (Russell).

Synonymy.—*Hydrus nigrocinctus, H. cantori, Distira jerdoni.*

History.—I discovered what I take to be the type in the Royal College of Surgeons' Museum (No. 528). It was one of Russell's collection, and a comparison with Plate XII. of Russell's Volume II. left no doubt in my mind that it was the subject of the plate. On the other hand, Boulenger claims as the type a specimen in the British Museum from Madras collected by Dr. Jerdon. Cantor's name given in 1847 is invalid as he confused two species. In consequence, Gray stands as its official godfather, and his name given in 1849 is retained to denote the species.

General Characters.—A snake of moderate size and stout habit, growing to about 3 feet in length. Head moderately elongate, moderately depressed, and considerably broader behind than before the eyes. Snout of moderate length, narrowing terminally, much bowed in profile, and slightly projected downwards. Eye rather large for a hydrophid. Commissure of mouth slightly turned up behind. Neck hardly evident. Body robust everywhere, cylindrical anteriorly, compressed in midbody and posteriorly; the extreme depth hardly or not twice the depth anteriorly.

Identification.—One of the easiest of the seasnakes to identify. The costals anteriorly numbering 17, posteriorly 19 to 21, with a rostral touching only four shields will suffice to

* I have examined these teeth in many other specimens.

identify it. The last supralabial is quite characteristic, being very large and touching the parietals behind the postocular. The third infralabial is also quite distinctive, being the largest of the series and touching two scales only behind. The costals are also distinctive, being broader than long everywhere.

Colouration.—Olivaceous dorsally, merging to yellowish ventrally. The young are surrounded by from 31 to 41 black bands, with usually intermediate dorsal black spots or bars. As the snake ages the bands tend to fade, and eventually may be entirely obliterated ventrally leaving dorsal bars.

Habits.—There is nothing special to remark upon.

Food.—No special observations have been made on diet.

Breeding.—(*a*) *The Sexes :* I have not been able to discover any differences in lepidosis in the sexes, and there is no disparity in their length. The male claspers are not bifid.

(*b*) *Method of Reproduction :* It is viviparous like other hydrophids.

(*c*) *Season :* My one gravid female, which was in an advanced state of pregnancy, was killed at Madras on June 25. I had four young from Siam killed in January that ranged between 387 and 460 mm. (15¼ and 18⅛ inches).

(*d*) *Period of Gestation :* Not known.

(*e*) *The Brood :* The gravid female alluded to already contained three large sacs 70 mm. (2¾ inches) long, with one female and two male embryos. The female fœtus was 292 mm. (11½ inches), and the male were 280 and 298 mm. (11 and 11¾ inches). Both the latter had their genitalia exserted.

Growth.—(*a*) *The Young :* No precise measurements for the young at birth are available, but they are probably just over 305 mm. (12 inches). My smallest postnatal length is 387 mm. (15¼ inches).

(*b*) *Maturity :* My prospective mother was 838 mm. (2 feet 9 inches).

(*c*) *Maximum Length :* My largest example was 915 mm. (3 feet).

Poison.—Nothing known. It has not been worked with in the laboratory, and there are no recorded casualties from its bite.

Lepidosis.—The head shields preserve great constancy, and the variation in the scale rows and ventrals is notably small for a seasnake.

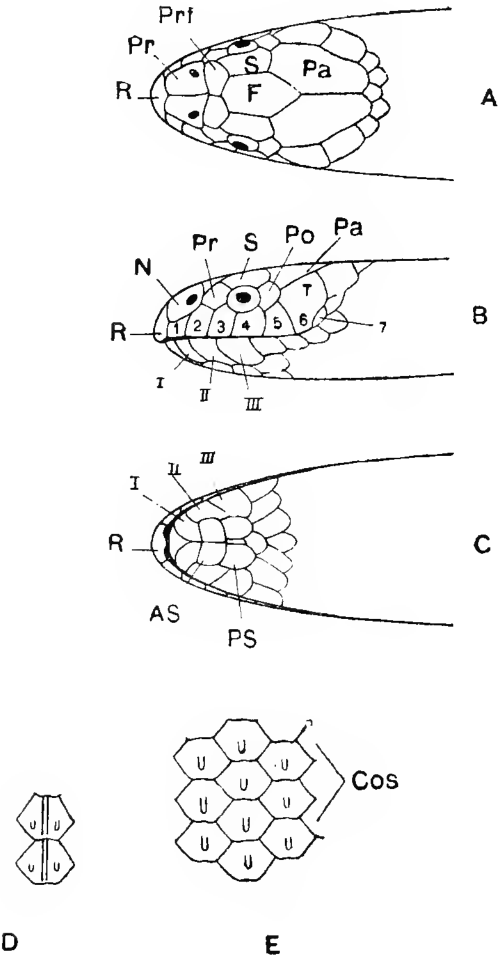

FIG. 73.—Kerilia jerdoni.
(Life size.)

(*a*) *Typical—Rostral:* About as broad as deep; the portion visible above three-quarters to equal to the suture between the nasals. *Nasals:* Usually no sutures proceed from the nostrils. *Præfrontals:* Do not touch any supralabial. *Frontal:* Entire; much longer than broad; the fronto-parietal sutures subequal to or rather longer than the fronto-supraoculars. *Supraoculars:* Length about two-thirds to three-quarters the frontal; breadth about two-thirds the frontal. *Parietals:* Entire; touching the postoculars. *Præoculars:* One. *Postoculars:* One. *Temporals:* Anterior confluent with the sixth supralabial; a well-developed posterior shield also lies along the parietals. *Supralabials:* Six; all entire and well developed; the 1st and 2nd touching the nasals; 3rd and 4th the eye; 6th confluent with the anterior temporal and the largest of the series. *Sublinguals:* One or two small pairs, the anterior the larger. *Infralabials:* Three; the suture between the first subequal to or smaller than that between the anterior sublinguals; third touching two scales behind. *Cuneate:* None.

Costals: Broader than long and imbricate everywhere, with a short keel, sometimes bidentate, occupying about the median two-fourths of each scale. In 17 rows two heads-lengths behind the head; 19 to 21 at midbody; and 19 to 21 two heads-lengths before the vent. *Ventrals:* 219 to 248; entire everywhere, less than twice the breadth of the last row, with a complete very obtuse median keel, and short subterminal lateral keels. (See fig. 73, D.)

(*b*) *Anomalies—Præfrontals:* Rarely meet the 2nd supralabial. I have seen a confluence with the præocular bilaterally in one example. *Postoculars:* Rarely two. *Sublinguals:* Rarely, even the anterior are too poorly developed to deserve the name. *Infralabials:* Rarely four.

Costals: Rarely in 16 or 18 rows two heads-lengths behind the head.

Dentition: Detailed under the genus.

Distribution.—(*a*) *General:* Coasts of India from Travancore to the Malay Peninsula.

(*b*) *Local :* There are two specimens in the Bombay Natural History Society's collection, but evidence that these are from the Malabar Coast is lacking. Ferguson mentions a specimen from Trivandrum. There were two specimens in the Colombo Museum of local origin. It is a rather uncommon snake in the vicinity of Madras. What I take to be Russell's type is from Tranquebar. It is uncommon on the Coromandel Coast as far North as Puri. I failed to get one from Burma, and can find no records from this coast. Several specimens in the Indian Museum are from the region of Mergui. Cantor, the Skeat Expedition, and Annandale and Robinson obtained it from the coasts around the Malayan Peninsula, and Dr. Malcolm-Smith sent me four juvenile specimens from the coasts of Siam.

I have examined about thirty specimens.

Genus PRÆSCUTATA.

(Latin " præ " in front, " scuta " a shield, refers to the unusually well-developed anterior ventrals.)

General Characters.—Length moderate. Habit robust. Body anteriorly moderately attenuated, the diameter being about half that of the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals :* Sutured to præfrontals and frontal, as long as the frontal. *Præfrontals :* Not meeting parietal, meeting postfrontals. *Frontal :* Broader than long, meeting postfrontal at rim of orbit. *Parietal :* Keeled inferiorly. *Quadrate :* Oblique from above backwards, extreme length superiorly half its depth. *Maxilla :* not extending beyond palatine anteriorly, extending beyond palatine posteriorly.

Dentition.—From one skull in my collection. *Maxillary :* Postnodal, 4 to 5 ;* feebly scaphiodont. *Palatine :* 7 ; anododont, isodont ; curving outwards anteriorly ; with a

* I have examined these in many specimens.

short edentulous space posteriorly. *Pterygoid:* 17; anododont, feebly scaphiodont; posterior two-fifths edentulous. *Mandibular:* 16 to 17; anododont, scaphiodont.

There is one species, viz., *viperina.*

PRÆSCUTATA VIPERINA (Schmidt).

(Latin, meaning "like a viper.")

Schmidt's Seasnake.

Synonymy.—*Thalassophis viperina, Distira viperina, D. lapemidoides, D. præscutata, Hydrophis obscurus, H. doliata H. jayakari, H. plumbea, H. nigra.*

History.—Described and christened by Schmidt in 1852. The type specimen is in the Hamburg Museum.

General Characters.—A snake of fair proportions and robust habit, growing to about 3 feet. Head moderate, rather broad, depressed. Snout moderate in length, gently declivous, very broadly rounded. Eye small. Commissure of mouth turned up posteriorly. Neck fairly apparent. Body cylindrical and of moderate calibre in the anterior two-fifths, where its depth is about half to three-fifths the extreme depth posteriorly; much compressed and fairly robust in the posterior three-fifths.

Identification.—A very easy species to recognize, owing to the unusually broad anterior ventrals, which are about four times the breadth of the last costals. The frontal shield is also very distinctive, being as broad or nearly as broad as long. It is also one of the few hydrophids in which the præfrontal shields do not touch the 2nd supralabials.

Colouration.—Grayish or olivaceous gray dorsally, merging to pale-yellow or whitish ventrally. The body is adorned

with from 26 to 38 black bands or bars, often of a rhombic shape and with a tendency to confluence vertebrally. The adornment is very variable, and the colour varieties may be grouped as follows :—

A.—With complete bands, often confluent vertebrally, but discrete ventrally. Analogous to variety A of *ornata*, and *spiralis* and B of *cyanocincta*. A rare form. Jerdon's specimen in the British Museum from Madras and one of Sir Joseph Fayrer's specimens (No. 8,277) in the Indian Museum from Puri furnish good examples.

B.—Intermediate between A and C. With dorsal bars anteriorly, and complete bands posteriorly. A young specimen in the Indian Museum from Puri, presented by Sir Joseph Fayrer, is the only example I know.

C.—*typica* (Schmidt). With dorsal bars throughout; discrete or more or less confluent vertebrally. The usual Indian form, which is very comparable to form *typica* of *ornata*, variety C of *spiralis*, and D of *cyanocincta*.

D.—Like the last, only the bars replaced by rhombs, the angles of which often meet vertebrally. A common variety, of which I have seen examples from Karachi, the Malabar Coast, and Ceylon.

E.—*jayakari* (Boulenger). With a continuous broad black stripe dorsally, as though the bars of variety C were completely confluent. This band is sharply defined costally. Completely analogous with variety E of *ornata*. Not very uncommon. I have seen examples from Muscat, Bombay, Puri, and the Orissa Coast.

F.—*nigra* (Anderson). This is completely black, and is to be regarded as a melanotic subject. It was captured at Puri and is in the Indian Museum.

Habits.—Nothing special has been observed. As regards progression I think it is not so helpless on dry land as most of the seasnakes.

Food.—No special notice has been taken of its diet.

Breeding.—No breeding events have been chronicled, and I have never seen a gravid specimen.

Growth.—(*a*) *Early Life :* A small specimen in the Colombo Museum is 432 mm. (17 inches), and was killed at Mount Lavinia on August 24, 1919.

(*b*) *Maximum Length :* Boulenger gives 920 mm. (3 feet and ¼ of an inch) for a specimen in the British Museum.

Poison.—Nothing known. This has not been experimented with, and there are no casualties on record.

Lepidosis.—(*a*) *Typical—Rostral :* As broad as or broader than deep ; the portion visible above half to two-thirds the length of the suture between the nasals. *Nasals :* Two sutures usually radiate from the nostril, one to the præfrontals, and one to the 2nd supralabials. *Præfrontals :* Touching no supralabials. *Frontal :* Entire ; as broad as or almost as broad as long ; the fronto-parietal sutures nearly twice the fronto-supraoculars. *Supraoculars :* Length about three-fourths the frontal, breadth half or less than half the frontal. *Parietals :* Entire ; touching the upper postocular. *Præoculars :* One. *Postoculars :* Two. *Temporals :* Very irregular and usually not differentiated. Two or three superimposed scales anteriorly. *Supralabials :* Seven to nine, very variable ; the third and succeeding shields very prone to confluence or division ; 1st and 2nd touching the nasals ; 3rd and 4th, 3rd, 4th, and 5th, or 4th and 5th touching the eye. *Sublinguals :* Two fairly well-developed pairs, the fellows of each in contact. *Infralabials :* Four ; the suture between the first equal to or longer than that between the anterior sublinguals ; 4th largest and in contact with

three or four scales behind. *Cuneate:* One between the 3rd and 4th infralabials. (Fig. 74.)

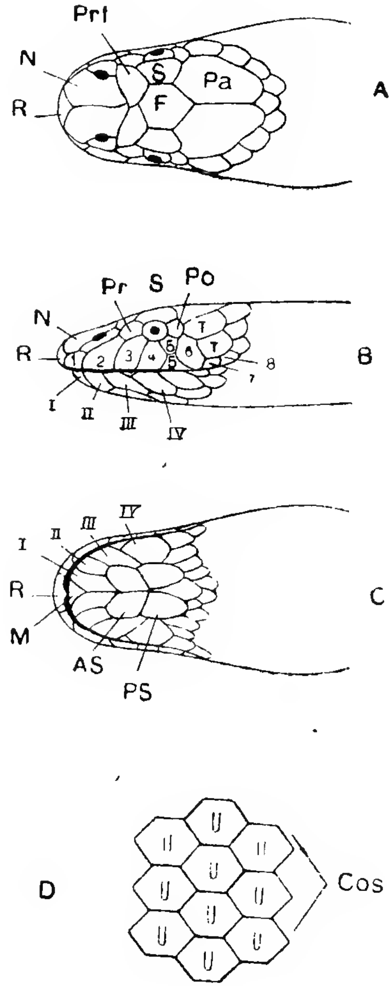

FIG. 74.—Præscutata viperina.
(Life size.)
D. Costals.

Costals: Longer than broad and imbricate in the cylindrical part of the body; about as broad as long, hexagonal, and juxtaposed in the compressed posterior part, with a short keel occupying about the median two-fourths of each scale. In 27 to 34 rows two heads-lengths behind the head; 39 to 50 in midbody; and 35 to 45 two heads-lengths before the vent. *Ventrals:* 235 to 276; entire and imbricate throughout; about four times as broad as the last costals for a short length anteriorly, nearly twice as broad as the last costal rows elsewhere.

(*b*) *Anomalies—Præfrontals:* I have seen this in contact with the 2nd supralabial on one side in two specimens. *Præoculars:* When the third supralabial is divided a spurious lower præocular is established. *Postoculars:* The divided fifth labial sometimes creates a spurious lower shield. *Sublinguals:* The fellows of the posterior pair are frequently quite separated. *Cuneate:* Sometimes two after the 3rd supralabial.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General:* From the Persian Gulf to South China; Malayan Archipelago as far East as Java. Boulenger does not include it in his snakes of the Malay Peninsula.

(*b*) *Local:* I have examined about thirty specimens. It is rare in the Persian Gulf. There is one specimen in the British Museum from Muscat, and one in the Indian Museum from the same port. There is one in the Bombay Natural History Society's collection from Karachi, and another from Karwar, and the British Museum collection has one from Malabar. It is not represented in the Trivandrum Museum. There was no specimen in the Colombo Museum when I examined the collection, and there is no record from Ceylon. It is rare on the southern Coromandel Coast. Dr. Henderson sent me two from Madras, and a third from the same locality is in the British Museum. Further North, however, it is not an uncommon species. There are no less than twelve specimens in the Indian Museum from Puri, and one in the Bombay

collection from the Orissa Coast. One in the Indian Museum from Rangoon appears to be the only record from that coast. This is No. 8,269 of Sclater's list identified by him as *H. dayanus*. Another in the same institution is from Mergui. The type is reported from Java. There is one in the British Museum from Hong Kong, and I saw two specimens in the Hong Kong Museum labelled "Swatow." Herz, too, obtained one irom Hainan.

Genus ASTROTIA.

(Der. unknown to me.)

General Characters.—Length considerable. Neck robust. Body massive.

Cranial Osteological Characters.*—*Nasals:* Sutured to præfrontals and frontal, longer than frontal. *Præfrontals:* Meeting parietal and postfrontals. *Frontal:* Broader than long, meeting postfrontal at rim of orbit. *Parietal:* Not keeled inferiorly. *Quadrate:* Oblique from above backwards, extreme length superiorly about half its depth. *Maxilla:* Not extending beyond palatine anteriorly, extending beyond palatine posteriorly.

Dentition.*—*Maxillary:* Postnodal, 7; feebly scaphiodont. *Palatine:* 7 to 8; anododont, isodont (?); no edentulous space posteriorly. *Pterygoid:* 20; anododont, isodont (?); posterior half edentulous. *Mandibular:* 18 to 19: anododont, scaphiodont.

There is one species only, viz., *stokesi*.

Astrotia stokesi (Gray).

Named in honour of Captain Stokes.

Stokes's Seasnake.

Synonymy.—*Hydrus major, H. stokesi, Hydrophis annulatus, H. guttata, Astrotia schizopholis, Distira stokesi.*

* I have no skull, and these details are taken from Boulenger's figures (Catalogue, Vol. III., p. 286).

History.—First definitely given specific rank by Gray in 1846, though known since 1802 to the same author who confused it with *H. major*.

General Characters.—A very massive snake growing to 5 feet in length. Head large, markedly depressed. Snout rather long, much bowed in profile, broadly rounded terminally, not projecting. Eye moderate. Nostril with usually a suture passing back to the præfrontal, and another to the 2nd supralabial. Commissure of mouth little turned up posteriorly. Neck not or hardly evident. Body stout, and cylindrical anteriorly, and about three-fifths the extreme depth ; massive and compressed posteriorly.

Identification.—The only seasnake in which the 4th, 5th, and 6th supralabials touch the eye, except *Hydrus platurus*. The only seasnake, except *cantoris*, in which the 1st, 2nd, and 3rd supralabials touch the nasals. The absence of any enlarged ventrals and the absence of any sublinguals are also very notable features in its identification.

Colouration.—Yellowish, with from 24 to 34 black bands or bars, with usually linear vertebral black bars in the intervals. Often there are a dorsal and a ventral series of bars in the middle and posterior parts of the body, which tend to alternate costally. The ventral bars may be broken up into several series of spots of variable size (*H. guttata*, Murray).

Habits.—There is nothing special known.

Food.—No special observations have been made as to the nature of its diet.

Breeding.—(*a*) *Method of Reproduction :* Definitely known to be viviparous.

(*b*) *Season :* The only recorded breeding event concerns a specimen in an advanced stage of pregnancy reported by Boulenger, which was captured in the month of August.

(*c*) *Period of Gestation :* Not known.

(*d*) *The Brood :* Boulenger's specimen was found to contain twelve young and two sterile eggs. The young varied in length from 305 to 407 mm. (12 to 16 inches).

Growth.—(*a*) *The Young:* The exact measurements at birth are not known.

(*b*) *Maturity:* The gravid female referred to above measured 1,474 mm. (4 feet 10 inches).

(*c*) *Maximum Length:* A specimen mentioned by Gunther is 1,550 mm. (5 feet 1 inch), and I examined a specimen in the Colombo Museum of almost exactly the same proportions. The extreme girth of Gunther's specimen was reported as 254 mm. (10 inches). The girth of a Colombo specimen was 228 mm. (9 inches). D'Albertis in his book "New Guinea" (1880, Vol. I., p. 179) mentions one killed off the coast of New Guinea that measured 1,830 mm. (6 feet).

Poison.—Nothing known. No casualties have been reported, and no experimental laboratory work accomplished.

Epiphytes.—The specimen alluded to by Boulenger was covered with a dense growth of algæ. Two or three species of *Ulvæ* and two or three species of *Enteromorphæ* were identified.

Lepidosis.—(*a*) *Typical—Rostral:* About as deep as broad; the portion visible above about half to two-thirds the suture between the nasals. *Nasals:* Sutures from the nostrils, if present, proceed to the præfrontals posteriorly and the 2nd supralabial. *Præfrontals:* Touch the 2nd supralabials. *Frontal:* Entire; longer than broad; the fronto-parietal sutures equal to or rather longer than the fronto-supraoculars. *Parietals:* Entire; touching the upper postoculars. *Præoculars:* One. *Postoculars:* Two. *Temporals:* Not developed, replaced by small scales. *Supralabials:* Eight to eleven, subject to much variation; the 3rd and succeeding shields frequently divided into an upper and lower part, forming the suboculars, third postoculars, and lower temporals of some authors. The 1st, 2nd, and 3rd touch the nasals; 4th, 5th, and 6th the eye. *Sublinguals:* Absent. *Infralabials:* Very variable and subject to division; the 1st, 2nd, or 3rd

may be entire. *Cuneate:* A complete row succeeds the 1st, 2nd, or 3rd infralabials. (Fig. 75.)

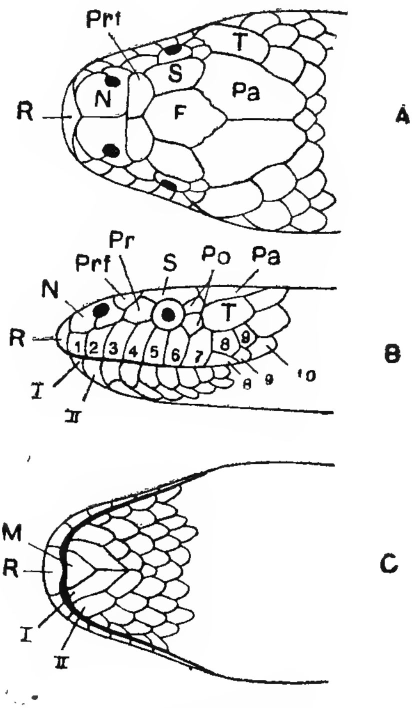

FIG. 75.—Astrotia stokesi.
(Life size.)

Costals: Longer than broad and strongly imbricate everywhere, with irregularly dentate posterior borders, especially in the lowest rows; with short keels, sometimes bidentate in the median four-sixths of each scale. In 41 to 48 rows two heads-lengths behind the head; 48 to 59 in midbody; and 41 to 50 two heads-lengths before the vent. *Ventrals:* Absent except for a short length anteriorly, replaced afterwards by 230 to 267 paired strongly imbricate scales, with irregularly dentate posterior borders. *Anal:* Variable.

(*b*) *Anomalies—Præfrontals:* Sometimes touch the 3rd as well as the 2nd supralabials, rarely completely separated from any supralabials. *Supraoculars:* Rarely partly divided transversely.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General:* From the Mekran Coast to the Chinese sea and North Australia.

(*b*) *Local:* It is apparently a rare snake everywhere. There is one specimen in the British Museum from Mekran (the type of *H. guttata*, Murray), and Boulenger records another from Karachi Harbour. There is one in the Trivandrum Museum recorded by Ferguson. These appear to be the only examples known from the Malabar Coast of India. It is not represented in the Bombay Natural History Society's collection, and I have failed to procure any specimen from this coast. I found two examples in the Colombo Museum of local origin. There is no record from the Coromandel Coast of India, and it is not represented in the Indian Museum, Calcutta. There are two specimens in the British Museum from Singapore. Gunther throws doubts on its occurrence in the Chinese sea, and I saw no example in any of the Chinese Museums. Practically all the other known specimens are from the Australian Coasts. I have only seen about ten specimens.

Genus ENHYDRINA.

(Greek " en " in, " hudor " water.)

General Characters.—Length up to 4 feet. Habit robust. Body moderately attenuated anteriorly, its diameter about half to two-thirds the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals:* Not sutured to præfrontals or frontal; confluent posteriorly (a feature unique among hydrophids); longer than frontal. *Præfrontals:* Not meeting parietal, meeting postfrontals. *Frontal:* As broad as long, meeting postfrontal at rim of orbit. *Parietal:* Strongly keeled inferiorly. *Quadrate:* Oblique from above backwards, extreme length superiorly half its depth. *Maxilla:* Extends beyond palatine anteriorly, not extending beyond palatine posteriorly.

Dentition.—From two skulls in my collection. *Maxillary:* Postnodal, 3 to 5; isodont. *Palatine:* 5 to 6; anododont, isodont; a short edentulous space posteriorly that would accommodate one tooth. *Pterygoid:* 15 to 16; anododont, feebly scaphiodont; one-third edentulous posteriorly. *Mandibular:* 16; anododont, scaphiodont.

There is one species, viz., *valakadyen.*

ENHYDRINA VALAKADYEN (Boie).*

(Borrowed from the vernacular name "valakadyen," which Russell stated was used by nativé fishermen on the Coromandel Coast.)

The Jew's-nosed or Boie's Seasnake.

Tamil: "valakadyen" (Russell) ("valla" strong, "kadyen" biter). *Bengali:* "Hoogly pattee" (Russell) about the Sunderbunds.

Synonymy.—*Hydrus valakadyen, H. schistosus, Disteira russelii, Polyodontes annulatus, Hydrophis schistosa, H. benga lensis, H. fasciatus, H. subfasciata, Enhydrina bengalensis, E schistosa, Pelamis schistosus.*

History.—Figured by Russell in 1801 on Plates X. and XI of his second volume. Christened by Daudin in 1803 as *schistosa* (*vide* footnote). What I take to be the type I discovered in the Museum of the Royal College of Surgeons, London (No. 523). It appears to me the specimen from Tranquebar figured by Russell on Plate XI. of his second volume, and was one of the collection presented by the East India Company to the above institution, most of which has since been transferred to the British Museum.

General Characters.—A snake of fair proportions growing to 4½ feet. Head large, moderately long, little depressed, skin

* I do not concur with Boulenger in thinking Plate X. of Russell's second volume a distinct species from Plate XI. I agree with those herpetologists, and they are many, who think that the figure on Plate X. reprèsents the same species as Plate XI. If this opinion is correct, this snake should be known by the name *schistosa* given it by Daudin in 1803, while Boie's name *valakadyen* dating from 1827 should be suppressed. I prefer, however, to retain the title with which all have been familiar for so many years.

swollen and loose. Snout rather short, much bowed in profile, obtusely rounded terminally, projecting below the level of the lip. A pronounced furrow in the chin. Commissure of mouth turned up posteriorly. Eye moderate, with dull greenish iris. Neck stout, not or hardly apparent. Body elongate, robust; forebody subcylindrical and two-thirds to half the depth at the greatest girth (one-third in heavily gravid females); much compressed posteriorly, very heavy in gravid females.

Identification.—The downward projection of the rostral shield to well below the level of the lip, and the pronounced furrow in the chin are both features peculiar to this seasnake. The outer suture from the nostril, with few exceptions, passes to the first supralabials, a peculiarity only seen in one other seasnake, viz., *Enhydris hardwickei.*

Colouration.—Very variable. The young are bluish or bluish gray, with many well-defined black annuli, often dilated vertebrally. As age advances these bands become more and more obscured, first disappearing ventrally to become dorsal bars, and these in old specimens may disappear altogether. In old adults the dorsum is frequently a uniform bluish or bluish gray, merging at midcosta to yellow or yellowish. Both dorsal and ventral hues again are subject to much modification, according to whether the specimen has recently desquamated or is about to do so. In the latter case, the yellow on the belly becomes often tinged with brown.

Habits.—This is far the commonest seasnake around our shores and extraordinarily plentiful. On the Malabar Coast the fishermen brought them to me in bucketfuls until deterred from doing so. I have certainly had over fifty brought to me in one morning taken from their nets. On the Coromandel Coast at Madras and at Gopalpore I have seen the nets brought in with a dozen or more of these snakes among the haul. At Cannanore the men in the 75th Carnatic Infantry, fishing in the sea with lines, more often, it seemed to me, hooked this seasnake than a fish!

It frequently comes up tidal rivers, and several were captured for me at Watiya in Burma at a distance of 40 miles from the sea. It has been taken in Tolly's Nullah, Calcutta. 80 miles from the sea.

In Cannanore I kept several of these snakes in a dry masonry trough among my flower pots, where they lived many days without any water. Here they crawled about in a clumsy awkward fashion, but progression was far less hampered than is the case in the very thin-necked seasnakes. All these specimens were conspicuously gentle creatures, that I failed to provoke to bite an offending object. This placid disposition is well exemplified by the fact that the sepoys and others, who habitually bathed at Cannanore, were never bitten, plentiful as I have shown that the species is there.

Food.—They live entirely on fishes.

Breeding.—(*a*) *The Sexes:* Females appear to be more numerous than males from the few notes at my disposal. In Cannanore, of 13 specimens sexed, 8 were females. Again, of 19 fœtuses obtained in the same station, 12 proved to be females. The tubercles on the scales are rather more pronounced in males than in females. Each male clasper is bifid with its extremities beset with villose papillæ. A raphé passes from the cloaca up the inner face, and then to the back of the "stalk," where it divides to pass up each limb.

(*b*) *Method of Reproduction:* Definitely known to be viviparous.

(*c*) *Season:* The young are born during the months of February (? January), March, April, and May. I had a female containing eggs with no trace of embryo in November, and many others in various stages of pregnancy in December, January, and February. One of these captured on January 29 contained fœtuses 263 to 279 mm. ($10\frac{3}{8}$ to 11 inches) long, whose birth, judging from these measurements, must have been imminent. Again, I have had young as small as 317 mm. ($12\frac{1}{2}$ inches) in the latter half of June, which were probably born in May.

(*d*) *Period of Gestation:* Not known.

(*e*) *The Brood:* I have had many gravid females through my hands, and I find the brood numbers from four to nine. During the later stages of development the sacs are membranous and transparent, and the fœtuses lying in a bath of pellucid oily fluid, are clearly visible within. Some of these

sacs are 64 mm. (2½ inches) in length, and the dam with a brood of nine is necessarily very considerably distended.

Growth.—(*a*) *Intraoval Life:* The genitals in males are extruded in the later stages of development, but some time shortly before birth they are retracted within their sheaths, and are no longer visible when born. The heart in unborn young was found to beat about 26 times per minute.

(*b*) *The Young:* The young at birth measure about 254 to 279 mm. (10 to 11 inches). Gunther mentions a young specimen that measured 266 mm. (10½ inches), and I have extracted embryos that measured 279 mm. (11 inches).

(*c*) *Early Life:* The young double their length in the first year of life, and are then about 508 to 610 mm. (20 to 24 inches) long. At the end of the second year of life they appear (from very meagre figures) to be about 762 mm. (30 inches). Further observations are necessary to clear up this point.

(*d*) *Maturity:* My smallest mother measured 965 mm. (3 feet 2 inches) in January, a length which indicates that she was not more than three years old.

(*e*) *Maximum Length:* Average adults range from 915 to 1,220 mm. (3 and 4 feet). I have had larger examples, viz., a female 1,310 mm. (4 feet 3½ inches), and a male 1,398 mm. (4 feet 7 inches).

Poison.—(*a*) *Physical Characters:* Fraser and Elliot report that in its dried state it consists of "thin scales of a very pale yellow colour."

(*b*) *Yield:* Dr. Pinto, who collected the venom used by Fraser and Elliot for their experiments, obtained ·28 grammes of an impure dried poison from 60 dry glands, or an average of ·0045 per gland, or ·009 grammes of poison per snake.

(*c*) *Amount injected during a Bite:* Rogers estimated that the average amount injected at one bite represented ·01 grammes of dried residue. It is difficult to reconcile this estimate with Dr. Pinto's average yield. Fraser and Elliot's estimate is much lower, but could not be exactly stated owing to an accident.

(*d*) *Toxicity:* Russell caused one to bite a fowl, and the bird succumbed in five minutes! Rogers, experimenting on pigeons, found that *Enhydrina* venom was ten times more potent than

cobra venom. It does not follow, however, that the same relationship would hold good in the human subject. Lamb, indeed, speaking of cobra poison shows that the minimal lethal dose for rats is one-fourth that for pigeons per kilogram weight.

(*e*) *Lethal dose for Man :* It is impossible even to guess at the lethal dose for man, as the figures above quoted do not support one another.

(*f*) *Toxins—*

(1) Neurotoxins operating on nerve cells :

(*a*) A depressor paralysing the respiratory centre (Rogers, Fraser, and Elliot).

(*b*) A depressor paralysing centres in the bulb (inferred from the remarks of Rogers, Fraser, and Elliot).

(*c*) A depressor paralysing nerve endings, the phrenics especially (Fraser and Elliot).

(2) A direct stimulant to cardiac muscle (or nerve endings). Very feeble (Fraser and Elliot).

(3) Toxins affecting the constitution of the blood.

(*a*) Hæmolysin. Very feeble (Fraser and Elliot).

(*g*) *Analysis of toxic action—*

(1) (*a*) The "neurotoxin" paralysing the respiratory centre is the chief agent in producing death. It is powerfully assisted by (1) (*c*).

(*b*) This neurotoxin evokes symptoms of paralysis of the lips, tongue, throat, and voice.

(*c*) This assists (1) (*a*) in arresting breathing.

(2) This is so feeble in action as to be altogether a negligible factor in the toxæmia.

(3) (*a*) This affects the blood so little that hæmorrhages are not likely to be seen.

(*h*) *Symptoms of Toxæmia :* These have only been studied on lower animals in the laboratory. Rogers says there is no difference between the toxic manifestations of this species and the cobra.

Fraser and Elliot, however, have pointed out that there is much greater respiratory embarrassment with *Enhydrina* venom than cobra venom, and this is accounted for by the fact that in *Enhydrina* poisoning, the heart and blood vessels are practically unaffected by any direct action of the venom, whereas in cobra toxæmia both are markedly affected. Again, the paralysis of the end plates of the phrenic nerves is more pronounced than in cobra poisoning.

In the human subject then one would expect a clinical picture such as I have portrayed under the cobra. Over and above this, one would expect a greater degree of respiratory embarrassment. Hæmorrhages are not so likely to occur, and the local effects, according to Lamb, are slight. Death, as in other Colubrine toxæmiæ, is due to a paralysis of the respiratory centre.

(*j*) *Illustrative Case:* It is very remarkable that in spite of the abundance of this snake, literature does not furnish a single casualty in the human subject.

(*k*) *Treatment:* Fraser and Elliot have shown that Calmette's antivenene has a very feeble action in neutralizing the effects of the poison, so that this agent or the Kasauli preparation may be tried. Otherwise treatment should be symptomatic, and on the lines laid down for cobra poisoning.

Epizoa and Epiphyta; The following have been communicated to me by Dr. Annandale :—

(*a*) *Polyzoa: Alcyonidium mytili* (Dalzell).

(*b*) *Barnacles: Platylepas ophiophilus* (Lankester).

This latter has only been found on seasnakes.

Lepidosis.—(*a*) *Typical—Rostral:* Rather deeper than broad, projecting below the level of the lip. *Nasals:* The outer suture passes to the 1st supralabial. *Præfrontals:* Touch the 2nd supralabial. *Frontal:* Entire; longer than broad; the fronto-parietal sutures subequal to or longer than the fronto-supraoculars. *Parietals:* Entire. *Præocular:* One. *Postoculars:* One or two. *Temporals:* Variable; usually one large anterior nearly descending to the labial margin. *Supralabials:* Seven or eight; the first four usually entire, the rest subject to much variation. *Sublinguals:* Usually absent; two small pairs, both widely separated by

small scales, are regarded by some as such. *Infralabials :* Five ; the 5th touching three or four scales behind. *Cuneate :* None. (Fig. 76.)

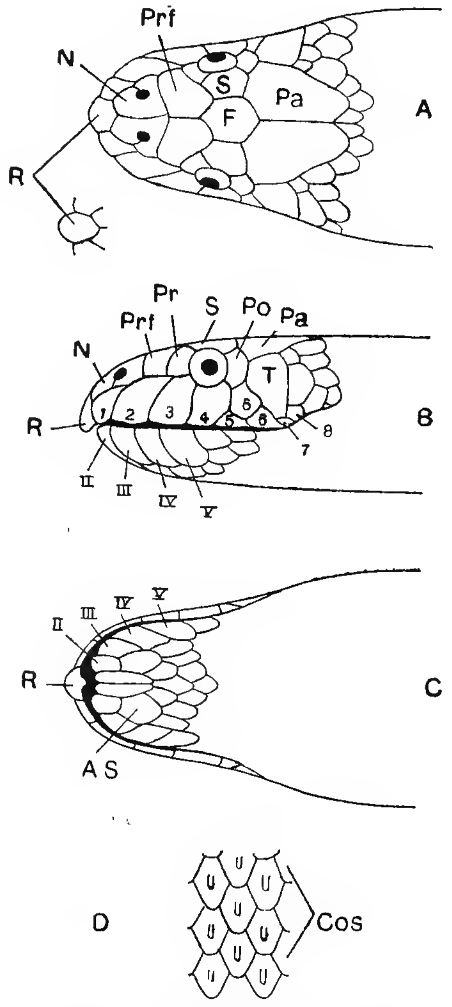

FIG. 76.—Enhydrina valakadyen.
(Life size.)
D. Costals.

In old males the head shields are studded with small granular tubercles.

Costals : Nearly as broad as long, imbricate or subimbricate everywhere ; with a median short keel, frequently twice or thrice denticulated, in the median third or three-fifths of each scale. In 47 to 61 rows two heads-lengths behind the head, 50 to 70 at midbody, and 50 to 70 two heads-lengths before the vent. Old males are very rough from the well-developed keels and their denticulations, especially ventrally, and in this respect resemble the males of some other seasnakes, like *cyanocincta*, *obscurus*, and *cærulescens*. *Ventrals :* 230 to 361 ; little broader than the last costal row, often divided, laterally keeled as in the last costal rows.

(*b*) *Anomalies—Nasals :* Rarely there are no sutures from the nostril ; rarely the outer suture passes to the 2nd supralabial. *Præfrontals :* Rarely fail to touch the 2nd supralabials. *Temporals :* Subject to much variation, division, or confluence with the subjacent supralabials. *Supralabials :* The 2nd rarely divided to form a pseudo-loreal ; the 3rd rarely divided to form a pseudo-præocular.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General :* From the Persian Gulf to New Guinea.

(*b*) *Local :* It is extremely abundant on both coasts of the Indian Peninsula. In Cannanore I probably procured ten specimens for every other seasnake. In Madras a collection of 192 seasnakes produced 60 *Enhydrinas*. It appears to be uncommon as far South as Ceylon, for Haly in 1891 reported no specimens were in the Colombo Museum, and I only saw one there when I examined the collection. I never saw one captured by the fishermen in Colombo when their huge nets were brought in. There is at least one in the British Museum labelled "West Ceylon." I can find no record from the Andaman Islands, though I found it extremely common on the coasts

of Burma. It is very common in the Mergui Archipelago, and Cantor reported it incredibly numerous off the coast of the Malay Peninsula. I can find but few records from the Malayan Archipelago, and Stejneger doubts if it occurs on the Japanese Coasts, or further North than perhaps Formosa. It was not represented in any of the Chinese Museums (Hong Kong, Shanghai, and Siccawee) when I visited these institutions in 1901 and 1902, nor in either of the two large collections of seasnakes from Japan and the Loo Choo Islands submitted to me by Mr. Owston.

Genus LAPEMIS.*

General Character.—Length rather short. Habit robust. Body moderately attenuated anteriorly, its diameter about half to two-thirds the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals:* Sutured to præfrontals and frontal; longer than frontal. *Præfrontals:* Meet the parietal; not meeting postfrontals. *Frontal:* Breadth two-thirds to three-fourths the length; meeting postfrontal at rim of orbit. *Parietal:* No keel inferiorly. *Quadrate:* Oblique from above backwards, extreme length superiorly three-fifths its depth. *Maxilla:* Not extending beyond palatine anteriorly, extending beyond palatine posteriorly.

Dentition.—From two species in my collection. *Maxillary:* Postnodal, 3 to 5; isodont. *Palatine:* 5 to 6; anododont, isodont; with a short edentulous space posteriorly that would accommodate one tooth. *Pterygoid:* 17 to 22; anododont, isodont; posterior third to fourth edentulous. *Mandibular:* 12 to 16; anododont, scaphiodont.

There are two species, viz., *curtus* and *hardwickei*.

* Stejneger (Herp., Japan, 1907, p. 435) points out that the generic name should be Gray's *Lapemis*.

LAPEMIS CURTUS (Shaw).

(Latin " curtus " short.)

Shaw's Seasnake.

Tamil : " potai pambu " (female snake) in Madras.

Synonymy.—*Hydrus curtus, Lapemis curtus, Hydrophis propinquus, H. curta.*

History.—Described by Shaw in 1802 from a young specimen labelled " India." The type is in the British Museum.

General Characters.—It is a small stout snake growing to about 2½ feet. Head massive, with strong jaws, moderately depressed. Snout moderate in length, broadly rounded terminally, declivous. Eye of moderate size, with dull greenish iris. Neck hardly evident. Body short, stout, cylindrical anteriorly; strongly compressed posteriorly; the depth anteriorly two-thirds to less than half the greatest depth posteriorly.

Identification.—The only Indian hydrophid with disintegrate parietal shields. The ventrals are hardly enlarged, except anteriorly, and number 130 to 219.

Colouration.—The dorsum is olivaceous green, merging about midcosta to pale-yellow. The back is beset with a series of dark, greenish-brown, or greenish-black, rather ill-defined, cross-bars, about 45 to 55 in number, and rather broader than the interspaces. The first of these passes across the back of the head. In the young these bars extend further ventrally, and often form complete bands.

Habits.—It frequents our Indian Coasts in large numbers. In rough weather, in common with other seasnakes, it appears to keep well out to sea, judging from the dearth of numbers brought in from the fishing nets at this time. I have known a specimen taken on land close to a backwater one and a half miles from the sea.

I have lately seen many specimens in the Madras aquarium. It moves expeditiously by lateral undulations, and is extremely graceful in its movements, looking at first sight much more like an elongate fish than a snake. Occasionally a minute pearl-like bubble is seen at each nostril, which in course of time is freed and floats up to the surface. Visits to the surface for a fresh intake of air are few and far between.

Food.—Remains of fish in the stomachs of many show that it depends upon this form of diet in common with other hydrophids. I have not been able to procure any fish in a suitable state to make identification probable.

Breeding.—(*a*) *The Sexes :* Out of 49 specimens collected in June and July, 1917, which I sexed, 21 were males and 28 females. The tubercles on the scales in females are feeble, but in males are stronger, and on the lowest costal rows in old adults actually spinose. The male claspers are not bifid.

(*b*) *Method of Reproduction :* It is definitely known to be viviparous.

(*c*) *Season :* The young are born between May and August. I had twelve gravid females from Madras between June 20 and July 12, 1917, the fœtuses ranging between 215 and 355 mm. (8½ and 14 inches). Nine other specimens already born ranged between 350 and 445 mm. (13¾ and 17½ inches). From this it is probable that the 445 mm. specimen had been born in May or even earlier, and that the 350 mm. specimens would not have been born till August or possibly later.

(*d*) *Period of Gestation :* Not known.

(*e*) *The Brood :* This species shares with *Microcephalophis gracilis* the distinction of being the least prolific of all the seasnakes known to me. Of twelve gravid females that have passed through my hands, four contained a single fœtus, and seven only two young. One specimen contained four embryos. Some of the sacs containing the young measured as much as 108 mm. (4¼ inches) in length.

Growth.—(*a*) *The Hatchling :* I have found unborn embryos measuring as much as 355 mm. (14 inches), and I have had

specimens which after birth measured 330 mm. (13 inches). The young then vary from 330 to 355 mm. (13 to 14 inches). The embryo is retained until it has reached a very remarkable degree of development, many extracted by me being fully half and sometimes more than half the length of the mother.

(*b*) *Early Life :* The young appear to grow about 6 to 8 inches in the first year of life, as proved by seven of my specimens in June and July measuring 483 to 553 mm. (19 to 21¾ inches) long. If this rate of growth is maintained they would be about 686 to 762 mm. (27 to 30 inches) at the end of the second year of life.

(*c*) *Maturity :* Most of my gravid females measured from 686 to 825 mm. (27 to 32½ inches). From this it will be seen that many are mothers by the time they reach two years of age. Thus, compared with the majority of land snakes, Shaw's seasnake shows a marked precocity in attaining to sexual maturity.

(*d*) *Maximum Length :* My largest specimens measured 846 mm. (2 feet 9½ inches). One was a male, the other a female.

Poison.—(*a*) *Physical Characters :* Fraser and Elliot report the dried product as consisting of thin scales of a very pale yellow colour.

(*b*) *Yield :* Dr. Pinto found the average yield from eight fresh specimens represented ·00284 grammes of dried residue.*

(*c*) *Toxicity :* The virulence of the poison, as ascertained by experiments on rats, was about one-seventh that of *Enhydrina* venom. Fraser and Elliot, however, do not lay great stress on the respective values of the two venoms experimented with, as they have found considerable variations in the toxicity of different samples of cobra venom collected under exactly similar conditions.

(*d*) *Lethal Dose for Man :* This can only be roughly guessed at, for it does not follow that because the lethal doses of two poisons are known for the rat, that for man they would bear

* Not ·00275, as stated by Fraser and Elliot.

the same relationship. Again, Fraser and Elliot, as just mentioned, do not attach too much importance to the results they obtained from a single sample of *curtus* poison. The lethal dose of this venom per kilogram weight for rats being ·0006 grammes and that for the cobra being ·0005, shows that to the rat the former is slightly less virulent. If man is as susceptible as the rat the lethal dose of the poison would be about ·00175 grammes. As the glands of an average adult specimen only yield about ·00284 grammes of venom they contain less than two lethal doses.

(*e*) *Toxins :* Apparently exactly similar to those of *Enhydrina valakadyen* (q.v.)

(*f*) *Symptoms :* Fraser and Elliot, from experiments on the lower animals, conclude that the symptoms are almost exactly the same as in cobra poisoning. The one marked difference noted by them was that respiratory embarrassment is much more severe than in cobra poisoning, and this is due to a much greater degree of paralysis of the ends of the phrenic nerves than is the case in cobra poisoning, over and above the paralysis of the respiratory centre. The vaso-motor centre and the vagi are not affected, unlike cobra poisoning.

(*g*) *Illustrative Case :* None is available, there being no record in past literature of a casualty attributable to *curtus*.

(*h*) *Treatment :* This should be as recommended for cobra poisoning. Fraser and Elliot have demonstrated that Calmette's antivenene affords a feeble measure of protection against the venom of Shaw's seasnake.

Lepidosis.—(*a*) *Typical—Rostral :* Broader than deep. *Nasals :* A suture from the nostril passes to the second supralabial. *Præfrontals :* Touch the second supralabial. *Frontal :* Entire ; the fronto-parietal sutures longest. *Supraoculars :* Length half to three-fourths the frontal, breadth two-thirds to three-fourths the frontal. *Parietals :* Disintegrate, usually divided into three subequal parts. *Præocular :* One. *Postoculars :* One. *Temporals :* Small, variable. *Supralabials :* Seven or eight ; first 3, 4, or 5 entire, the rest subject to division and much variation, and forming the so-called lower

postoculars and temporals of many authors. The 1st and 2nd touch the nasals; and the 3rd and 4th the eye. *Sublinguals :* Absent. If any scales are sufficiently well developed to merit the name of anterior sublinguals, they are completely separated by small scales. *Infralabials :* Four; the 4th largest and in contact with three or four scales behind. *Cuneate :* A complete row after the 2nd infralabial. (Fig. 77.)

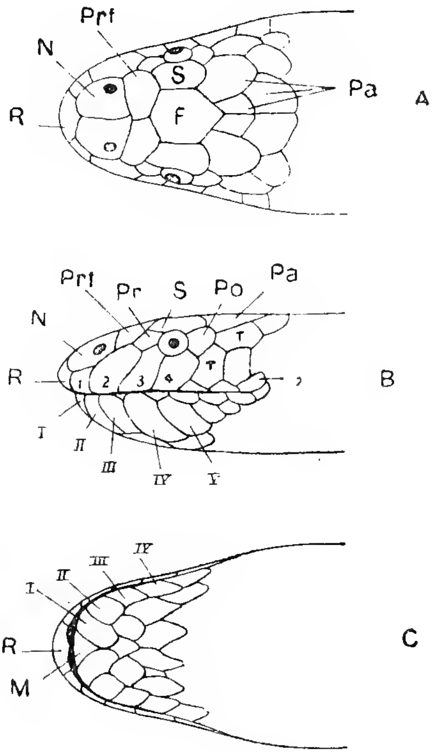

Fig. 77.—Lapemis curtus.
(Life size.)

Costals: As broad or broader than long; square, oblong, or hexagonal; juxtaposed everywhere, with a central tubercle Last three or four rows enlarged, with the tubercles in old males developed into prominent spines. Two heads-lengths behind the head 29 to 36; at midbody 30 to 45; two heads-lengths before the vent 30 to 42. *Ventrals:* 151 to 219; entire, and slightly broader than the last costals anteriorly; divided posteriorly for a variable length, each half with a central tubercle, or in old males spines. *Anal:* Divided into four or six.

(*b*) *Anomalies—Rostral:* Sometimes partly divided in the median line above. *Nasals:* The suture from the nostril very rarely passes to the 1st supralabial. *Præfrontals:* Very rarely fail to meet the 2nd supralabial; very rarely touch the 3rd as well as the 2nd. *Frontal:* Rarely partly disintegrate posteriorly. *Parietals:* Very rarely not broken up; sometimes broken up into more than three parts. *Postoculars:* Rarely two. *Supralabials:* The 3rd sometimes divided, forming the so-called loreal of some authors. The 3rd as well as the 1st and 2nd very rarely touch the nasals. Sometimes the 3rd, 4th, and 5th, or the 4th only, touch the eye. *Infralabials:* Rarely the cuneate scales fail to meet, and so allow the 3rd, or 3rd and 4th, to partly reach the border of the lip.

Dentition.—From three skulls in my collection. *Maxillary:* Postnodal, 3 or 4. *Palatine:* 5 to 6. *Pterygoid:* 18 to 22. *Mandibular:* 12 to 16.

Distribution.—(*a*) *General:* From the Persian Gulf to the Malay Archipelago.

(*b*) *Local:* I have found it very common on the Malabar Coast (Cannanore) and Coromandel Coast (Madras). One collection of 192 hydrophids from Madras furnished 84 examples of Shaw's seasnake. There were three specimens in the Colombo Museum when I examined the collection, and others from the Ceylon coast are preserved in the British Museum. It appears to be rare on the Burmese side of the Bay of Bengal, for out of many seasnakes collected for me I have had no specimen. The Indian Museum had one

specimen (No. 11,531) from Mergui. It appears to be rare also in the Malayan region, as Flower does not mention it. It was not represented in the large collection made by Annandale and Robinson from the Malay Peninsula, but Boulenger says the Skeat Expedition obtained it from Singapore. The Indian Museum has a specimen (No. 14,547) from Borneo.

LAPEMIS HARDWICKEI (Gray).

(Named in honour of General Thomas Hardwicke.)

Hardwicke's Seasnake.

Synonymy.—*Lapemis hardwickei, L. loreatus, Hydrophis pelamidoides, H. hardwickei, H. loreata, H. fayreriana, H. abbreviatus, H. brevis.*

History.—First described by Gray in 1834 from a specimen Gunther believed to be captured at Penang, and now in the British Museum. Boulenger, however, gives the locality as "India."

General Characters.—A moderate-sized stout species, which grows to about 3 feet. Head large, broad, moderately depressed. Snout rather long, declivous, obtuse terminally. Eye moderate. Neck not or hardly evident. Body short, stout, compressed from shortly behind the neck. Anteriorly the depth is about two-thirds the greatest depth.

Identification.—The juxtaposed character of the costals everywhere, the enlargement of the last three or four rows, taken with the few ventrals (130 to 214) and entire parietals will establish the species. The suture from the nostril almost always passes to the 1st supralabial, a feature only to be seen in *Enhydrina valakadyen,* and rare aberrant examples of *L. curtus* and *Chitulia ornata* among Indian hydrophids.

Colouration.—Dorsally pale dirty greenish, ventrally pale yellow; with about 27 to 43 bars across the dorsum of the

body. These are deep seaweed-green or blackish-green, broader than the intervals, and narrow subcostally. They are well defined in young examples, and usually grow more and more ill-defined with age. In some examples the bars are replaced by bands that completely encircle the body (variety *annulata* of Fischer). Both bars and bands may be confluent on the spine, and the anterior bands are often confluent ventrally. The head is dark seaweed-green or blackish, more or less mottled with yellow, the latter hue tending to form a horseshoe-shaped mark, which becomes more and more obsolescent as age advances. The tail is barred like the body, and black at the tip.

Habits.—No special remarks have been recorded that I can find.

Food.—I can find no allusion to any special fish eaten.

Breeding.—No events have been published.

Growth.—*Maximum Length :* Gunther gives the length of one as 915 mm. (3 feet).

Poison.—There is no record of a casualty from this snake, and the poison has not been experimented with in the laboratory.

Lepidosis.—(*a*) *Typical—Rostral :* About as deep as broad. *Nasals :* Two sutures usually pass from the nostrils, one backwards to the præfrontals, and the other outwards to the 1st supralabial. *Præfrontals :* Touch the 2nd supralabial. *Frontal :* Entire, the fronto-parietal sutures longest. *Parietals :* Entire, touching the postoculars. *Præoculars :* One. *Postoculars :* One, two, or three. *Temporals :* Not differentiated ; replaced by scales which are extremely variable in number and disposition. *Supralabials :* Seven or eight ; the 1st and 2nd touching the nasals, and the 3rd and 4th the eye. The anterior 3, 4, or 5 entire, the rest subject to division and great inconstancy. *Sublinguals :* Absent or so small as not to deserve the name. If recognizable as such, the anterior are completely separated by small scales. *Infra labials :* Four or five ; the 4th largest and touching three or

four scales posteriorly. *Cuneate:* A complete row from behind the 2nd infralabial. (Fig. 78.)

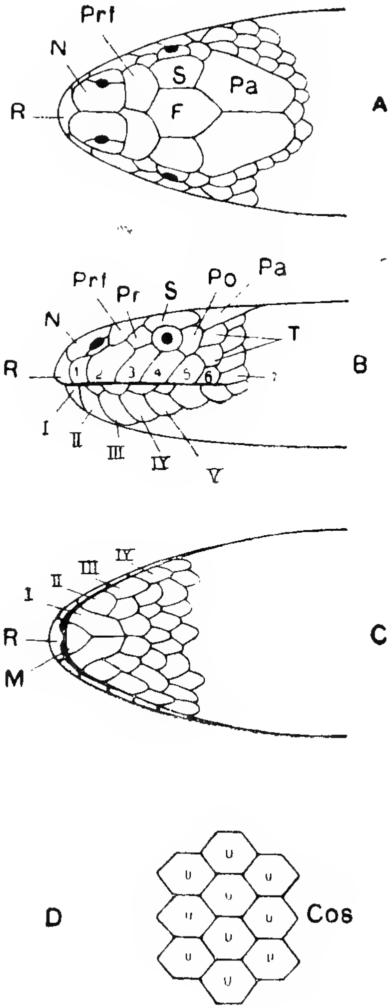

FIG. 78.—Lapemis hardwickei.
(Life size.)
D. Costals.

Costals : As broad as or broader than long, last three or four rows enlarged ; square, oblong, or hexagonal ; juxtaposed everywhere, with a central tubercle, which may be obscure in the anterior part of the body in females, strong in males, and those in the lowest three rows spinose in old males. In 25 to 33 rows two heads-lengths behind the head ; 27 to 40 in midbody ; and 27 to 37 two heads-lengths before the vent. *Ventrals :* 130 to 214 ; not enlarged, except to a variable extent anteriorly ; otherwise, smaller than the last costals. *Anal :* divided into four or six parts.

(*b*) *Anomalies—Rostral :* Sometimes with a partial suture in the median line above. *Nasals :* Sometimes divided by more than two sutures radiating from the nostril. One such integral part forms a pseudo-loreal on one side in the type specimen, and similar specimens led Gray to separate them under the name *loreata.* The outer suture rarely runs to the 2nd supralabial. *Præfrontals :* Rarely touch the 3rd as well as the 2nd supralabial. Rarely touch no supralabial. *Frontal :* Rarely more or less disintegrate posteriorly. *Parietals :* Sometimes very irregularly disintegrate. *Supralabials :* The 2nd, 3rd, 4th, or 5th sometimes divided into an upper and lower part ; 3rd and 5th, or 4th or 5th, only touching the eye, owing to a confluence of the normal shields. *Cuneate :* Sometimes not a complete series, the 5th infralabial reaching the labial border.

Dentition.—From one skull in my collection. *Maxillary :* Postnodal, 3 to 5. *Palatine :* 5 to 6. *Pterygoid :* 17. *Mandibular :* 13 to 14.

Distribution.—(*a*) *General :* Bay of Bengal through the Malayan region to New Guinea and Philippines.

(*b*) *Local :* Apparently very rare on the western side of the Bay of Bengal. The only record I can find is Fayrer's specimen from Puri, Orissa, in the Indian Museum (No. 8,270), which Anderson made the type of *fayreriana.* I have failed to procure a single specimen on our Indian (including Burmese) Coasts out of the many hundreds of hydrophids that have passed through my hands. It is evidently common in the Mergui Archipelago, for I have examined no less than eleven examples from that locality preserved in the Indian Museum.

It appears to be fairly abundant in the Malay Archipelago. It is common further east around the Philippines, and I had no less than seven specimens in a small collection from that locality. It does not seem to have been recorded from the Chinese Coast, and I think when Flower includes the Chinese sea within its limits he means the southern part of that sea. Stejneger says that its claim to be considered a Japanese snake is dubious. It was not represented in the two large collections of seasnakes made by Owston around Japan and the Loo Choo Islands, which formed the subject of my papers published in the proceedings of the Zoological Society of London in 1903 and 1905.

There is no record from Ceylon, and it is only included in this list by me because it has been found in the Bay of Bengal.

Genus HYDRUS.

(Greek "hudros" water-snake.)

General Characters.—Length rather small, about 2 feet. Habit robust. Slightly attenuated anteriorly, its diameter about two-thirds the extreme depth posteriorly.

Cranial Osteological Characters.—*Nasals :* Sutured to præfrontals and frontal; longer than frontal. *Præfrontals :* Not meeting parietal, meeting postfrontals. *Frontals :* Breadth three-fourths its length, meeting postfrontals at rim of orbit. *Parietal :* Strongly keeled inferiorly. *Quadrate :* Oblique from above backwards; extreme length superiorly half its depth. *Maxilla :* Not extending beyond palatine anteriorly; extending beyond palatine posteriorly.

Dentition.—From three skulls in my collection. *Maxillary :* Postnodal, 8 to 10; isodont. *Palatine :* 6 to 7; anododont, scaphiodont; no edentulous space posteriorly. *Pterygoid :* 23 to 27; anododont, isodont; posterior quarter edentulous. *Mandibular :* 16 to 18; anododont, scaphiodont.

There is one species, viz., *platurus.*

HYDRUS PLATURUS (Linné).

(Greek "platus" flat, and "oura" tail.)

Linne's Seasnake.

Synonymy.—*Anguis platura, Hydrus bicolor, Pelamis schneideri, P. ornata, P platurus, P bicolor, Hydrophis platura, H. pelamis, H. bicolor.*

History.—First described by Linné in 1766. The type was preserved in Stockholm.

General Characters.—Rather a small snake, growing to little over 2 feet in length, and rather eel-like in conformation. Head large, elongate, much depressed. Snout very long, broadly rounded terminally, slightly declivous. Eye moderate. Neck fairly evident. Body compressed, of nearly uniform calibre throughout, with a sharp ridge along the back, deepest near midbody, attenuating to the neck and posteriorly. Belly forming an obtuse keel.

Identification.—The costals broader than long, and in 40 to 54 rows two heads-lengths behind the head, will distinguish this from other seasnakes. The figure-of-8 tubercles are only seen in two other hydrophids, viz., *Microcephalophis gracilis* and *cantoris*. Its colouration too is very distinctive, and if once seen the snake cannot be mistaken for any other species of seasnake.

Colouration.—There are several colour varieties, which may be grouped as follows :—

Variety (A) (= the *bicolor* of Schneider and variety E of Boulenger's Catalogue, Vol. III., p. 268) : Head chocolate or black above, yellow beneath. Body with a broad stripe dorsally of the same colour as the head. The lower edge of the stripe is straight, or festooned posteriorly, and sharply demarcated from the pale yellow of the sides and belly. A paler intermediate lateral stripe may separate the dorsal and ventral hues. Tail with black dorsal bars and lateral spots.

This is by far the commonest variety on our coasts. Some specimens have a series of black costal spots in the yellow, or these may be confluent and form a more or less irregularly outlined stripe. (Variety C of Boulenger's Catalogue.) Such specimens are not infrequent.

I have seen specimens in the Indian Museum from Ceylon and Puri. Six out of thirteen examples in the Colombo Museum are of this variety. One has a paler yellow intermediate stripe, and one a pale narrow vertebral stripe. A specimen in the Bombay Natural History Society's collection from Madras and another in the Indian Museum from the

Nicobars have the posterior part of the dorsal stripe festooned instead of straight, and thus constitute a form transitional between varieties A and B.

Variety (B) (=the *ornatus* of Gray, the *maculatus* of Jan. and varieties A and B of Boulenger's Catalogue): In this the dorsal stripe is broken up into cross-bars in the whole body length or for a variable extent posteriorly, and a series of costal spots alternates with the bars. It is a rare form known from Borneo, but dubiously from our coasts.

Variety (C) *subobscurus* (Wall) (=variety D of Boulenger's Catalogue): Like variety A, but the yellow is replaced by a khaki hue. In some the hues are separated by a yellow line. I saw three such with a yellow line from Ceylon in the Colombo Museum, and there is one from Bombay in the British Museum. One without the yellow line in the Indian Museum is from Travancore, and two in the Colombo Museum are from Ceylon. Three of the five in the Colombo Museum have the dorsal stripe festooned posteriorly.

Variety (D) (=variety G of Boulenger's Catalogue): The name *pallidus* would suit this form. It differs only from variety A, in that the sides and belly are whitish or grayish, and the dorsal stripe and caudal marks are much paler than normal, indeed, these may be almost obsolescent. Such a specimen from Travancore is in the British Museum. Two specimens I saw in the Colombo Museum, probably from Ceylon, another in the Indian Museum from the Persian Gulf, and a third in the Bombay Natural History Society's collection from Bombay, all of which I took at first to be very faded specimens, belong to this variety. The last is so pale and the vertebral stripe so extremely indistinct that I regarded it dubiously as an albino. Father Dreckman in 1913 wrote to me of a somewhat similar specimen he had recently acquired near Bandora on the Bombay Coast. This was a light gray colour, with a somewhat darker vertebral stripe. The tail had the usual characteristic black marks.

Habits.—Nothing special known.

Food.—I am not aware of any fish preyed upon having been identified.

Breeding.—(*a*) *The Sexes:* The tubercles on the scales are more pronounced in males, but even in the fœtus these are distinguishable in the female.

(*b*) *Method of Reproduction:* It is viviparous.

(*c*) *Season:* A specimen in the Colombo Museum in a very late stage of pregnancy was killed at Mount Lavinia on March 9, 1919. A young example 237 mm. ($9\frac{1}{2}$ inches) was killed on May 11, 1915.

(*d*) *Period of Gestation:* Not known.

(*e*) *The Brood:* The gravid female mentioned contained two sacs 62 mm. ($2\frac{1}{2}$ inches) long containing fœtuses measuring 244 and 254 mm. ($9\frac{3}{4}$ and $10\frac{1}{8}$ inches). No male genitalia were to be seen, so that unless both were females, the fœtuses were almost at full term. It is interesting to note of this family that the dam conforms to variety *subobscurus*, and has no yellow lateral stripe. One fœtus is also of variety *subobscurus*, but differs from the mother in having a yellow lateral stripe, and the margin of the dorsal stripe festooned posteriorly. The other fœtus is of variety *bicolor*, and the dorsal stripe is not festooned posteriorly.

Growth.—(*a*) *The Young:* The measurements of the young at birth have not been taken, but may be inferred from the measurements of the fœtuses given above and the fact that three young specimens in the Colombo Museum measure 237, 256, and 262 mm. ($9\frac{1}{2}$, $10\frac{1}{4}$, and $10\frac{1}{2}$ inches) respectively.

(*b*) *Maturity.*—The prospective dam measured 635 mm. (2 feet 1 inch).

(*c*) *Maximum Length.*—My largest record is 722 mm. (2 feet $4\frac{1}{2}$ inches).

Poison.—In "Land and Water" (November 15, 1879) is an account of one that climbed up the anchor chain of a man-of-war in the Ganges. An unfortunate midshipman who tried to capture it was bitten and died shortly afterwards.

Epizoa.—Dr. Willey ("Spolia Zeylanica," 1906, p. 207, and 1910, p. 180) has remarked upon two barnacles that attach themselves to this snake. These are *Conchoderma virgatum*, variety *hunteri* (Owen), and *Lepas anserifera* (Linné) Dr. Annandale has informed me of others, viz.,

* *Lepas tenuivalvata* (Annandale), *Dichelaspis warwicki* (Gray), and a species of **Platylepas*, the specific identity of which has not yet been determined. (Fig. 79.)

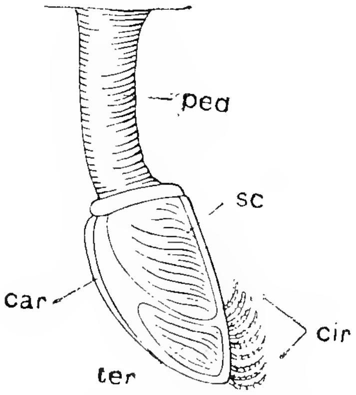

FIG. 79.—Common barnacle.
(Lepas anserifera.)
car = carina or keel.
cir = cirri.
ped = pedicle or stalk.
sc = scutum.
ter = tergum.

Lepidosis.—(*a*) *Typical—Rostral:* Broader than high. *Nasals:* Usually no suture from the nostrils to the labials. *Præfrontals:* Touch the 2nd supralabial. *Frontal:* Longer than broad, shorter than the parietals; the fronto-parietal sutures are subequal to or rather longer than the fronto-supraoculars. *Supraoculars:* About three-fourths the length of the frontal, and about three-fourths the breadth of that shield along a line connecting the centres of the eyes. *Præocular:* One. *Postoculars.* Two or three. *Temporals:* Not differentiated, replaced by small scales. *Supralabials:* Seven to eleven; the 2nd largest; the first three usually entire, but all the rest are subject to division, and hardly two specimens are quite alike; the 1st and 2nd touch the nasals; and the 4th

* Only found as yet attached to seasnakes and not any inanimate objects.

and 5th, or 4th, 5th, and 6th, touch the eye. *Sublinguals :* If discernible as such, small and separated by many scales. *Infralabials :* Five, all touching the labial margin. *Cuneate :* None. (Fig. 80.)

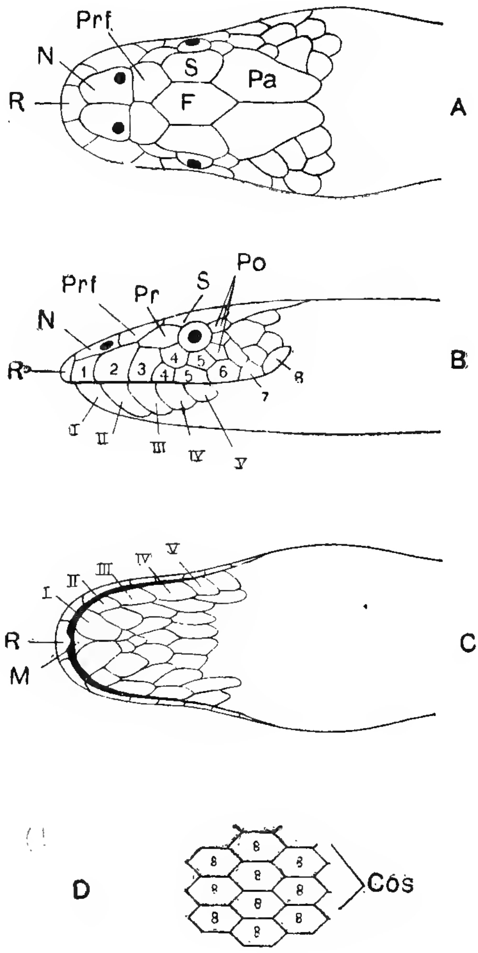

FIG. 80.—Hydrus platurus.
(Life size.)
D. Costals.

Costals: Broader than long, hexagonal, and juxtaposed everywhere. Each scale has figure-of-8 tubercles centrally on the ventral aspect; a single central tubercle at about midcosta, but dorsally these may be absent. They are most pronounced in males, and obsolescent in females and young. Two heads-lengths behind the head they number 40 to 54, 41 to 61 at midbody, and 41 to 61 two heads-lengths before the vent. The rows are more numerous in females. *Ventrals:* 284 to 339; not well developed, being little, if at all, larger than the adjacent costals; bituberculate laterally. *Anal:* Divided into four parts.

(*b*) *Anomalies—Nasals:* When an outer suture is present it passes from the nostril to the 2nd supralabial. *Præfrontals:* Sometimes do not meet the 2nd supralabial, owing to the contact of the nasal with the præocular. *Supralabials:* Except the first two or three all are subject to division, forming the so-called loreals, lower præoculars, and suboculars of some authors. *Sublinguals:* One or two pairs of slightly enlarged scales, both always widely separated may be taken as such in many specimens.

Dentition.—Detailed under the genus.

Distribution.—(*a*) *General:* Persian Gulf to Tenasserim and the Andamans. Beyond Indian limits it has a very wide range, extending to Japan, Australia, New Zealand, South Africa, and the western coast of North America.

(*b*) *Local:* It is moderately abundant around the Indian Coasts. Ferguson, speaking of Ceylon, remarks that it is common about Colombo and the pearl fisheries. Varieties A, D, and E have been met with around the Ceylon Coasts.

Genus LATICAUDA.*

(Latin "latus" flat, "cauda" tail.)

General Characters.—Head relatively broad. Nostrils lateral, pierced in an elongate entire nasal shield. Length moderate. Habit robust. Body of even calibre and cylindrical throughout. Tail highly compressed.

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* As pointed out by Stejneger (Herp., Japan, 1907, p. 402) Laurenti's *Laticauda*, dating from 1768, has a prior claim to Latreille's *Platurus*, which dates from 1802.

Cranial Osteological Characters.—*Nasals:* Not sutured to præfrontals or frontal; longer than frontal. *Præfrontals:* Not meeting parietal or postfrontals. *Frontal:* Broader than long, meeting postfrontals at rim of orbit. *Parietal:* Not keeled inferiorly. *Quadrate:* Oblique from above backwards; extreme length superiorly two-thirds its depth. *Maxilla:* Extends beyond the palatine anteriorly; not extending beyond palatine posteriorly.

Dentition.—From skulls of three species in my collection. *Maxillary:* Postnodal, 1. *Palatine:* 5 to 6; anodonont, isodont; with a short space posteriorly that would accommodate one tooth. *Pterygoid:* 13 to 17; anododont, scaphiodont; posterior two-fifths edentulous. *Mandibular:* 9 to 12; anododont, scaphiodont.

There are two species within Indian limits, viz., *laticaudata* and *colubrina*, and one further east, viz., *schistorhyncha*, Boulenger's *muelleri* I cannot separate from the first named.

LATICAUDA LATICAUDATA (Linnẹ).

(Latin "latus" flat, "cauda" tail.)

Linné's Sea Krait.

Synonymy.—*Coluber laticaudatus, C. platycaudatus, Laticauda scutata, Platurus fasciatus, P laurenti, P. laticaudatus P. fischeri, P. affinis.*

History.—First introduced to science by Linnẹ in 1758. The type is in the Stockholm Museum.

General Characters.—A moderately-sized snake, growing to about 3 feet. The facies reminds one forcibly of the land kraits of the genus *Bungarus.*

Identification.—Among Indian hydrophids it is easily recognized by the broad ventrals and lateral nostrils.

Colouration.—The body and tail are broadly banded with blackish-brown and bluish-gray. The former bands are the broader, involve about four scale rows dorsally, and number about 33 to 47 on the body and 5 on the tail. The lighter bands are yellowish ventrally. The head has a blackish-

brown band produced forwards to the anterior edge of the frontal, and a patch on the upper lip of the same colour. Elsewhere it is yellow.

Habits.—*Haunts:* Essentially marine, but has been found on land in the vicinity of the sea. Its cylindrical body enables it to progress on land with comparative ease, whereas other seasnakes, owing to their highly compressed bodies, can only flounder about without making progress.

Food.—I know of no special observations having been made in this direction.

Breeding.—I found, when examining the specimen in the Indian Museum (No. 8,289), that it contained seven eggs, but I omitted to note whether these contained embryos or not. Unfortunately, there is no record of the date of this specimen's capture.

Growth.—*Maximum Length:* The largest specimen I have examined was 1,093 mm. (3 feet 7 inches), and was taken by Mr. Owston off the Loo Choo Islands.

Poison.—Nothing known.

Lepidosis.—(*a*) *Typical—Rostral:* Height greater than breadth, touching six shields; the rostro-labial sutures twice or more than twice the rest. *Internasals:* A pair; the suture between them rather longer than that between the præfrontal fellows, about two-thirds the internaso-præfrontals. *Præfrontals:* A pair; the suture between them half or little more than half the præfronto-frontals; touching the internasal, nasal, præocular, and supraocular. *Frontal:* Longer than broad, touching six shields; all the sutures subequal, or the fronto-parietals rather the longest. *Supraoculars:* Length about three-fifths that of the frontal, breadth about three-fifths that of the frontal along a line connecting the centres of the eyes. *Parietals:* Touching the upper postoculars. *Nasal:* More than half the distance between the eye and the end of the snout. *Præocular:* One. *Postoculars:* Two. *Temporals:* One anterior and two posterior; anterior about as long as the supraocular. *Supralabials:* Seven; the 1st, 2nd, and 3rd touching the nasal; the 3rd and 4th the eye; and

5th and 6th the anterior temporal. *Sublinguals:* Two well-developed pairs, the posterior in contact and touching the 4th and 5th infralabials. *Infralabials:* Five; the 4th and 5th subequal and separated from the labial margin by a series of cuneate scales. (Fig. 81.)

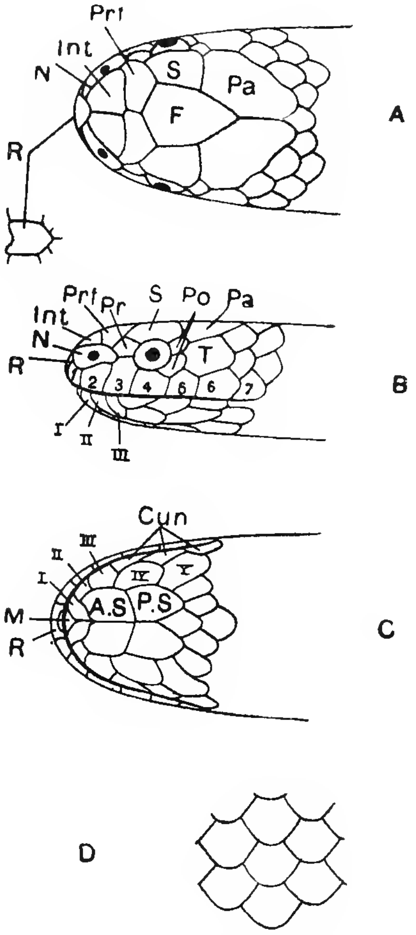

FIG. 81.—Laticauda laticaudata.
(× 1½.)
D. Costals.

Costals: Rectiform, broader than long, rounded apically, imbricate and smooth everywhere. Vertebral row not enlarged, except where the costals are 17. In 19 rows two heads-lengths behind the head; 19 in midbody; 19 or 17 two heads-lengths before the vent. *Ventrals:* 210 to 246. Very broad, fully three times that of the ultimate row of costals; with a more or less distinct lateral obtuse keel on the basal half of each shield; sometimes with an obtuse median keel in the posterior part of the body. The last frequently divided. *Anal:* As broad as the ventrals; divided. *Subcaudals:* 25 to 47.

(*b*) *Anomalies—Supralabials:* Rarely eight; sometimes the 3rd fails to touch the nasals; rarely the 4th touches the eye. *Infralabials:* The 3rd sometimes is cut off from the margin of the lip by cuneate scales.

Dentition.—From one skull in my collection. *Maxillary:* Postnodal teeth, 1. *Palatine:* 5. *Maxillary:* 16 to 17. *Mandibular:* 12.

Distribution.—(*a*) *General:* Bay of Bengal from Calcutta through the Malayan region, China, Loo Choo Archipelago, Philippines to New Guinea the South Pacific Islands (Fiji, Friendly, and Society), and Australia (Tasmania).

(*b*) *Local:* It has never been recorded from Ceylon, but I have already given my reason for including it in the Ceylon list.

On the Indian shores it is evidently extremely rare. The only records are one killed in Tolly's Nullah, Calcutta, and one collected by General Hardwicke. The former was preserved in the Indian Museum, Calcutta (No. 8,289), and was the subject figured by Fayrer (Thanatophidia, Plate XIX.). The latter, with no precise information as to habitat, is in the British Museum.

Of the many hundreds of Indian seasnakes that have passed through my hands no single specimen proved to be this species. It seems probable that it is only an accidental visitor to the

Indian Coasts, driven thence, perhaps, by storm or strong currents. It is apparently a rare visitor also to seas much further East, since Flower, in his Reptiles of the Malay Peninsula and Siam, mentions but one record, viz., from Chantaboon, Siam. It is not included in the collection made by Annandale and Robinson from the Malay Peninsula (Boulenger, Fasc. Malayensis, October, 1903), and in Boulenger's Fauna of the Malay Peninsula (Rept. and Batrach., 1912, p. 196) the author does not include it in the list.

Its usual habitat is evidently the Loo Choo Archipelago, Formosa, and the Philippines, and in these waters it is fairly abundant.

LATICAUDA COLUBRINA (Schneider).

(Latin, implying "like a coluber.")

Schneider's Sea Krait.

Synoymy.—*Coluber laticaudatus, Hydrus colubrinus, Laticauda scutata, Platurus scutatus, P. fasciatus, P. laticaudatus.*

History.—First referred to by Linné in 1766, who confused it with the last species *laticaudata.* Schneider in 1799 realized the difference between the two species, and his name for it is retained.

General Characters.—A snake of fair proportions reaching 4 feet in length. Commissure of mouth not turned up behind.

Identification.—The rostral touching six shields, and the scales in from 21 to 25 rows two heads-lengths behind the head, and 21 to 25 rows in midbody and posteriorly will declare the species. It is also the only Indian hydrophid with the frontal touching seven shields.

Colouration.—Dull bluish-gray, with from 25 to 50 very deep brown annuli round the body, and 4 to 5 round the tail. The bands are about as broad or broader than the interspaces, well defined and discrete vertebrally and ventrally. As age

advances their definition becomes obscured, especially ventrally, where they may be suppressed, leaving dorsal bars. Head deep brown above, and yellow on the tip of the snout and lips.

Habits.—It is reported to leave the water sometimes and crawl about on the rocks, and the cylindrical bodily conformation explains its capability of doing so. Captain Lloyd, who captured specimens at Sandaway Island on the Burmese Coast, found them in pairs in January among the submerged rocks well out to sea. It is reputed to be a gentle snake disinclined to bite.

Food.—A fish extracted by me from one was pronounced by Mr. Boulenger a young *glyphiodon.*

Breeding.—Nothing known.

Growth.—(*a*) *Maximum Length :* The longest measurement given by Boulenger is 1,270 mm. (4 feet 2 inches). Gunther says the longest of fifty specimens examined by him is 1,525 mm. (5 feet).

Poison.—Nothing known. No casualties are reported, and the poison has not been put to experimental tests.

Lepidosis.—(*a*) *Typical—Rostral :* Deeper than broad, touching six shields ; the rostro-labial sutures longest. *Internasals :* A pair. *Præfrontals :* Three in one transverse series, not touching any supralabial. *Frontal :* Entire ; longer than broad, touching seven shields ; the fronto-parietal sutures appreciably the longest. *Supraoculars :* Length half to three-fourths the frontal, breadth half to three-fourths the frontal. *Parietals :* Entire ; subequal to the length of the frontal, touching the upper postoculars. *Nasals :* Entire. *Præoculars :* One. *Postoculars :* Two. *Temporals :* One, fairly well-developed anterior shield. *Supralabials :* Seven ; all well developed ; 1st, 2nd, and 3rd touching the nasals ; 3rd and 4th the eye. *Sublinguals :* Two fairly well-developed pairs, the fellows of which are in contact. *Infralabials :* Four ; 4th largest and in contact with three or four scales posteriorly ; the suture between the first much shorter than that between

the anterior sublinguals, 4th only touching the posterior sublinguals. *Cuneate:* A complete row after the 2nd infralabial.

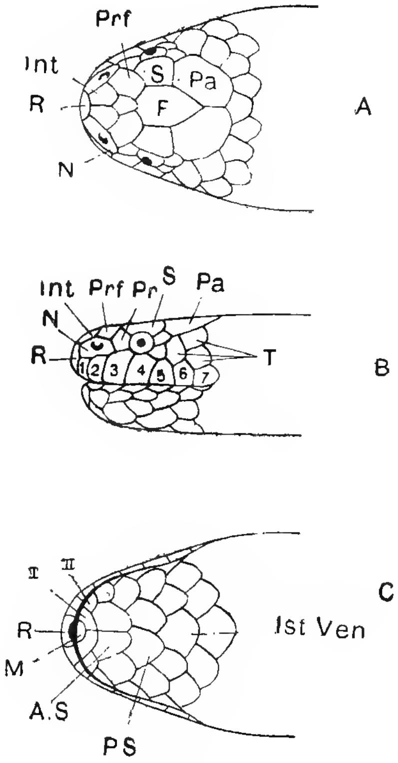

FIG. 82.—Laticauda colubrina.
(Life size.)

Costals: As broad as long, imbricate, and smooth everywhere; in from 21 to 25 rows two heads-lengths behind the head; 21 to 25 at midbody; 21 to 23 two heads-lengths before the vent. *Ventrals:* 195 to 240; three or more times the breadth of the last costals; last divided. *Anal:* Divided into two parts. *Subcaudals:* 30 to 45; divided.

(*b*) *Anomalies—Præfrontals:* The median one is rarely absent. *Temporals:* The anterior is sometimes divided into two superimposed parts. *Supralabials:* Rarely six.

Dentition.—From one skull in my collection. *Maxillary:* Postnodal,* 1. *Palatine:* 6. *Pterygoid:* 13. *Mandibular:* 9.

Distribution.—(*a*) *Generaal:* Bay of Bengal to Chinese sea. Loo Choo Islands. Western South Pacific Ocean.

(*b*) *Local:* Its favoured haunt is the Western South Pacific Ocean, where it is not an uncommon snake. Around the Loo Choo Islands it is a fairly common species. I have examined many of Mr. Owston's collecting from this region. I saw one in the Hong Kong Museum labelled "Penang," and there is one in the British Museum from the same place. The eastern side of the Bay of Bengal appears to be the extreme western limit of its distribution. There are two in the Indian Museum from the Nicobars, two from Sandaway Islands, and one from Ramri Island on the Burmese Coast.

Sub-family 8 **Elapinæ.**

(Named after the type genus *Elaps.*)

General Characters.—Head moderate to broad, snout short or moderate, with a slight indication of a canthus. Eye moderate in size, with a round or vertical pupil. Nostril small or moderate and lateral. Neck more or less evident. Body moderate or long; depressed, cylindrical, or compressed; slender or robust. Belly rounded. Tail short to moderate, cylindrical.

Identification.—No external characters can be relied upon to indicate the sub-family, which is recognized by the proteroglyphous maxillary dentition coupled with the cylindrical tail.

Habits.—Terrestrial. Viviparous or oviparous.

Food.—Mammals, birds, reptiles, and batrachians.

Poison.—All are poisonous. Many of the species rank among the most poisonous of snakes, and frequently deliver a death sentence with their bite.

Lepidosis.—The head is covered with large shields of the Colubrine type. The loreal is absent.

* I have examined these in several specimens.

Costals : Longer than broad, imbricate; rectiform or lateral rows somewhat oblique; smooth or keeled. Vertebrals enlarged in some, not in others. In from 13 to 25 rows. *Ventrals :* Rounded. Three or more times the breadth of the last costal row. *Anal :* Entire or divided. *Subcaudals :* Entire or divided.

Dentition (Indian species).—*Maxillary :* Proteroglyphous. Prænodal, two large canaliculate fangs. Postnodal, none in *Doliophis* and some *Callophis.* When present, number 1 to 4, grooved on their outer faces; isodont. *Palatine :* 6 to 14; isodont, or feebly scaphiodont. *Pterygoid :* 2 to 22 (Edentulous in *Doliophis*); scaphiodont. *Mandibular :* 8 to 21; scaphiodont.

Distribution.—Africa, South Asia, North, Central, and South America, Australia.

Twenty-eight genera are comprised in the sub-family, of which five come within Indian limits. Of these, three are represented in Ceylon, viz., *Naia*, *Bungarus*, and *Callophis.*

Genus BUNGARUS.

(Latinized version of the Telugu word "bungarum," gold. This name is applied by the Telugus to the banded krait *fasciatus,* which has canary bands.)

The members of this genus are many of them largish snakes exceeding 3 and even 6 feet in length. They are terrestrial, and certainly more nocturnal than diurnal in habit. They live almost entirely on other snakes.

General Characters.—The species attain to moderate or considerable proportions, varying from about 2 to 6 feet. Head subovate, moderately depressed, broadest midway between the eyes and the neck. Snout short, slightly declivous, without canthus, and broadly rounded terminally. Eye rather small, pupil round. Iris quite black in life, so that the shape of the pupil cannot be seen. Nostril rather large, round, occupying the full depth of the sutures between the nasals. Neck very little evident. Body rather long; cylindrical, or compressed; with shining scales; of even calibre

throughout. Belly rounded. Tail short or moderate, varying from one-eleventh to one-sixth of the total length. Acutely pointed or ending in a blunt extremity.

Identification.—The enlarged vertebrals taken with the entire subcaudals makes the genus an easy one to recognize.

Habits.—Terrestrial. Nocturnal. Rather sluggish. Inoffensive by nature.

Food.—Almost entirely serpentine.

Breeding.—Oviparous as far as is known.

Poison.—Very virulent. The bite of those that are known is usually fatal to man, excepting *fasciatus*, which rarely, if ever, occasions death.

Lepidosis.—*Rostral :* Touches six shields. *Internasals :* A pair. *Præfrontals :* A pair. *Frontal :* Touches six shields. *Nasals :* Divided. *Loreal :* Absent. *Præocular :* One. *Postoculars :* Two. *Temporal :* One. *Supralabials :* Seven. *Sublinguals :* Two pairs, the posterior shorter than the anterior. *Infralabials :* Four.

Costals : Vertebrals enlarged, gradually developing on the nape. Lateral rows longer than broad, the breadth of the upper about three-fourths their length and about two-thirds that of the ultimate row ; rectiform, smooth, without apical pits. Last three rows progressively enlarging. Ultimate row broadest, the breadth of its scales subequal to their length. In 13 to 19 rows at midbody. *Ventrals :* Rounded. *Anal :* Entire. *Supracaudals :* In odd rows, the vertebrals enlarged. *Subcaudals :* Entire (except towards the tip in *bungaroides*).

Dentition.—*Maxillary :* Postnodal, 1 to 4 ; isodont. *Palatine :* Anododont, isodont. *Pterygoid :* Anododont, isodont. *Mandibular :* Anododont, kumatodont. The teeth in the maxilla and mandible have shallow grooves on their outer faces, those in the palatine and pterygoid have similar grooves on their inner faces.

Distribution.—South-eastern Asia.

Eleven species have been described, two of which occur in Ceylon, viz., *cæruleus* and *ceylonicus*.

BUNGARUS CÆRULEUS* (Schneider).

(Latin "cæruleus" dark blue. The snake has a bluish sheen in certain lights.)

The Common Krait.

Tamil: "yennai viriyan" (oily snake), in allusion to its shining scales. "Yennai panayan" (oily snake), "yettadi viriyan" (8-foot snake). This implies that it is so poisonous that its victim will not move 8 feet from the time he is bitten.

Synonymy.—*Pseudoboa cærulea, P. krait, Boa lineata, Aspidoclonion semifasciatum, Bungarus candidus, B. semifasciatus, B. arcuatus, B. lineatus.*

History.—First depicted by Seba in 1735 (Thesaurus II., Plate LVI., Figs. 1, 3, and 4). Russell figured it in 1796 in his first volume, Plate I. Schneider christened it in 1801.

General Characters.—As detailed under the genus. A very handsome snake with glossy scales, growing to about 4½ feet. Body cylindrical. Tail about one-eighth to one-ninth the total length, attenuating to a point.

Identification.—The enlarged hexagonal vertebrals and entire subcaudals will proclaim it a *Bungarus.* From *ceylonicus* it will be distinguished by the fewer ventrals, the 2nd supralabial being as long as the 1st and 3rd, and by its twin white linear arches over the back. *Cercaspis carinatus, Lycodon striatus,* and one variety of *L. aulicus,* especially the first two, bear a close superficial resemblance to this species, but the scales and shields are very different.

Colouration.—Dorsally the snake is a shining lustrous black, with paired linear white arches across the back. The arches are more distinct posteriorly, and tend to become confluent vertebrally, and finally to disappear, especially

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* Boulenger refers to this as *B. candidus,* and considers our Indian form *cæruleus* as a variety. Similarly, Blyth's *multicinctus* and Wall and Evans' *magnimaculatus* are regarded as varieties. These four forms have a very distinctive colouration, and each its own restricted range of distribution, and I think may very likely regain their lost recognition as distinct species. Until I am satisfied of their specific unity I prefer to regard them as distinct species. To those who support Boulenger's opinion this form should be designated *Bungarus candidus,* variety *cæruleus.*

with age, anteriorly. The belly is pearly-white. The head is black above, merging to white on the upper lips. The young have the white arches particularly well defined and conspicuous, even anteriorly. They also have a partial or complete white collar, the back part of the head white, and two white vertical streaks in front of and behind the eye. Occasionally in adults the black has a mercurial lustre or the colour of a dark dun horse.

Habits.—(*a*) *Haunts*: Fayrer says: "It is found in the fields, grassy plains, rice khets, low scrubby jungle, and among débris of wood and buildings. It sometimes insinuates itself into houses, in the verandah, bathrooms, on the ledges of doors or jhilmils, into book cases, cupboards, &c." Millard writes to me: "It is very fond of living in the roofs of bungalows."

Theobald, speaking of kraits as a group, says: "They delight in water and its vicinity," an observation which receives support among others from Father Castets, S.J., who writes to me that in Trichinopoly "small specimens have been brought to me in bundles of twenty or more caught, as they said, in water." I have had several specimens brought to me that were captured in water. These were, I think, always captured in the hot weather, which seems to show that they grow very thirsty, and for this reason they frequently get into places from which they cannot extricate themselves, such as wells and the little pukka tanks connected with the irrigation arrangements so commonly seen in Indian gardens.

They appear to me to be commonest in the precincts of man, and to actually domicile themselves in human habitations for choice. Thus, the krait may usually be reckoned as one of the commonest snakes to be found about cantonments and even in the bazaars, and its numerical strength is probably little dreamt of by Indian residents. In Fyzabad, for instance, I obtained 47 specimens in June, July, and August, 1906, all caught or killed in cantonments. Judging from the weekly bags brought in by a snake-catcher at Delhi, it was probably as common in that station. A very large number of my specimens were encountered inside bungalows, outhouses, bazaars, and about jails. As a rule,

they have been found on the ground, or floors, far less commonly in roofs, or situations necessitating clambering efforts It appears to be decidedly nocturnal in habit, most of my specimens having been killed at night. Mr. Millard mentions in a letter to me that in captivity it likes to get away from the light, and Colonel Dawson informs me that "in captivity they never move, as a rule, during the day time, but become very active about dusk."

(*b*) *Disposition :* The krait is one of the most inoffensive snakes I know. I have had numerous living examples brought to me, and have kept several in captivity, so that my opportunities for studying its nature have been abundant. Time after time I have recorded the singular timidity of this snake in my notebooks, often under the greatest provocation, and only once have I seen one bite at anything of anger. This specimen had been impaled through and through by a trident, and could only move a few inches of its body behind the head. It must have been enduring the most fearful torture, but even in this predicament, though alert and lively, moving its head and quivering its tongue, it refused to bite things thrust at or held up to it. In trying to remove it from the rusty prongs that pierced its body, it endured the suffering for some time, but finally buried its teeth into a mass of fat that had escaped from its wounds, When freed it did not repeat the act, or betray any further vice. I noticed that two specimens I had caged together used periodically to grasp one another's bodies in their jaws, one shifting its grasp down the length of the other, as though seeking a favourable spot to commence devouring its mate.

Many specimens I played with or teased simply hid the head beneath coils and refused to move. Some I noticed flattened the hinder part of the body and inflated and deflated themselves anteriorly like many other snakes under excitement, and it is remarkable how expansive the lung must be, for in one specimen, in which marked inflation was noticeable from the 3rd to the 18th twin white arches, it was found upon subsequent dissection that the lung only reached as far back as the 7th twin arches. It very frequently emits the tongue

in a leisurely fashion when provoked. Its placid disposition banishes all fear, and tempts one to disregard any precautions in handling it, at least, this is my experience.

I noticed, especially in Delhi, years ago that Kallan, the most intrepid snake-catcher I have ever seen, who collected scores of poisonous snakes every week, treated the krait with supreme indifference, though he exercised the greatest caution in dealing with *Echides*.

Fayrer says: "In my experience I have always the greatest difficulty to get the cobra, krait, and daboia to bite voluntarily." Nicholson calls it a "very inoffensive" snake. Gleadow says: "I have always found it quiet, and not pugnacious." Mr. Millard tells me that it is "very shy." Colonel Dawson says: "It is a very shy snake, and rarely bites, except in self-defence or when hurt." This is fully exemplified by the behaviour of one snake which caused a fatality. This krait was unearthed while a man was digging. He picked it up, and tied a piece of cloth round its head, which the snake got rid of several times on the road from his house to Trivandrum Gardens. Arrived at the Gardens the snake again freed its head, and it was whilst trying to bind it on again that a bite was inflicted, which ended fatally. Dr. J. R. Henderson writes to me: "I have frequently kept this species living, but could make little of it, except that it appeared sluggish and not easily irritated."

The behaviour of a specimen placed by Russell with a cobra bears out the above opinions. He says: "The next subject opposed to the cobra, was a Gedi Paragoodoo" (common krait) "which, in all its movements, was much tamer than either of the former two" (*i.e.*, *Zamenis fasciolatus* and *Vipera russelli*), "and seemed solely intent on escaping out of the room or retreating into a dark corner. When pushed roughly on the cobra, and consequently struck by him, he made no resistance nor snapped in return; he did not even offer to retreat, but laid himself close to the cobra, whose body he often touched in his convolutions, without any apparent offence being taken." Colonel Dawson tells me that at Trivandrum when given a pot of sand or earth he has seen them trying to bury themselves.

(*c*) *Nocturnal or Diurnal:* It is decidedly nocturnal in habit. Nearly all the casualties recorded have occurred at night. Nearly all my specimens have been killed at night.

(*d*) *Sloughing:* The krait casts its skin probably every month. One in captivity in the Madras Museum, captured on November 7, 1896, sloughed on December 7, 1896, January 13 and February 27, 1897.

Food.—This species, like others of this genus, is in the main ophiophagous in habit, but in a state of nature, as well as in captivity, will partake of most other things offered. I have on many occasions found snakes eaten, once *Bungarus walli*, and once *Lycodon aulicus*, and on other occasions *Typhlops braminus*. In every case where young examples had fed *Typhlops* had been taken. Mr. Millard tells me that " those kept in the Society's Rooms refused all food but snakes." Dr. J. R. Henderson tells me, "I have frequently given a captured specimen a living snake to eat, and in most cases the latter was inside the krait by next morning. On one occasion one disposed of a *Dryophis* longer than itself." Father Dreckmann writes to me, " their food, as far as I can judge, consists exclusively of other snakes. I have never found anything else in their stomachs, and a very fine specimen disgorged three other snakes in different stages of digestion during the first night of its captivity." There are many other records where other snakes have been devoured. On the other hand, I have twice known frogs eaten, and Fayrer records a similar experience. In the Administration Report of the Madras Museum, 1896 to 1897, one specimen is reported to have eaten 2 frogs, and another 18 frogs during incarceration. I have twice found toads (*Bufo andersoni*) in the stomach, and once a monitor lizard (*Varanus flavescens*). Small mammals, too, are occasionally devoured. I once found a muskrat (*Crocidura cæruleus*) in gastro, and Assistant Surgeon Robertson told me he found five young muskrats taken on one occasion. I have twice seen a brood of young mice which had been swallowed, and in Bannerman's escaped specimen from the Parel Laboratory, when ultimately recovered, the meal consisted of six newly born rats. Lieut.-Colonel Liston, I.M.S., tells me that at Parel they have found

that both kraits and Russell's vipers readily eat the young fœtuses from rats in an advanced state of pregnancy.

Thirst.—This krait is a thirsty reptile. Impelled by thirst it is frequently discovered in wells or catch pits containing water in the garden, especially during the Indian hot weather.

Breeding.—(*a*) *The Sexes:* Males appear to be more numerous than females. Out of 67 sexed specimens in my notebooks I find 40 were males. Males also appear to attain a greater length, for I have had four exceeding 4 feet, whereas my largest females have been 1,067 mm. (3 feet 6 inches), 1,080 mm. (3 feet 6½ inches), and 1,112 mm. (3 feet 7¾ inches). The tail is rather longer in the male than in the female.

(*b*) *Anal Glands* The anal or scent glands secrete a blackish material of the consistency of a soft ointment. This has a peculiar, rather disagreeable but not very penetrating, odour. The glands in both sexes are active at all seasons, and at all ages from the time of hatching, so that I am inclined to question the popular belief fostered by Darwin* among others that they are concerned with the sexual functions.

(*c*) *Method of Reproduction:* It is definitely known to be oviparous in habit.

(*d*) *Season:* The mating season is probably in the months of February and March; but more observations on this point are badly needed.

(*e*) *Period of Gestation:* Not known.

(*f*) *Period of Incubation:* Not known. The female, after discharging her eggs, remains coiled up with them, at any rate, until they are well advanced towards incubation. In a case reported by Bannerman, the eggs which were found with the mother contained embryos "about 6 inches long." In another instance eggs unearthed with the mother in Bannu and sent to me were found to contain young embryos.

(*g*) *The Eggs:* I have had two different clutches sent to me for examination. The eggs in one clutch were described as being "like pigeon's eggs and plump." I found they measured 35 by 19 mm. (1⅜ by ¾ of an inch). They were white, elongate, the poles equally rounded, and the shell soft, yielding, and leathery, much like white kid.

* Descent of man, p. 539.

The number of eggs deposited varies from 6 to 10. They are placed beneath the earth. One clutch was unearthed in May, and two others in June, whilst removing an old stop butt on a range. They hatch out in May, June, and July.

Growth.—(*a*) *Length of Young:* When emerging from the egg the hatchling measures from 266 to 298 mm. ($10\frac{1}{2}$ to $11\frac{3}{4}$ inches).

(*b*) *Early Life:* The young double their length in the first year of life, and have trebled it by the end of the second year, being then about 315 mm. (3 feet) in length. In the third year they grow about 6 to 9 inches.

(*c*) *Maturity:* A gravid specimen, 890 mm. (2 feet 11 inches) long, indicates that the species is sexually mature at the end of the second year of life.

(*d*) *Maximum Length:* Specimens over 1,220 mm. (4 feet) long are unusual. My largest specimen taped 1,340 mm. (4 feet $4\frac{3}{4}$ inches). I have examined a skin that was 1,385 mm. (4 feet $6\frac{1}{2}$ inches), and as skins usually shrink a good deal it is possible the snake was 3 or 4 inches longer than this in life. Of 48 specimens used for experimental work in the laboratory, by Acton and Knowles, no less than 13 were 1,220 mm. (4 feet) or over. The largest measured 1,397 mm. (4 feet 7 inches).

Poison.—(*a*) *The Glands:* These are relatively smaller than in the cobra and situated behind the eye. A swelling in the temporal region indicates their position. They are somewhat retort-shaped, smooth, and when cut into reveal a cancellous structure resembling a sponge.

(*b*) *The Yield:* With some doubt Rogers estimated that an average adult could yield three lethal doses (for man ?) at a single bite. Acton and Knowles, assuming a degree ot susceptibility in man commensurate with that in monkeys—a very fair assumption—conclude that an average-sized krait could inject about 5·4 mgms. of dried poison, or five times the lethal dose for an average man.

It is extremely remarkable how very variable the yield of poison may be in individuals. Acton and Knowles found

the yield from one specimen measuring 4 feet 5 inches was only 0·2 mgms. of dried poison. Another specimen only 2 feet 8 inches long yielded 4·0 mgms., and a third specimen 3 feet 6 inches long yielded 51·4 mgms.! It will be seen from this that paradoxical as it may appear, a large krait does not necessarily inject a larger dose than a small one.

(*c*) *Physical Properties:* When freshly secreted the poison is a clear amber coloured fluid, resembling olive oil.

(*d*) *Toxicity:* Lamb, by experiments on rabbits, estimated the virulence of the poison at four to five times that of cobra venom. Rogers, operating on pigeons, estimated it at twice that of cobra venom. Acton and Knowles, by experiment on monkeys, estimate that it is sixteen times more potent than cobra venom!

(*e*) *Lethal Dose for Man:* Acton and Knowles, assuming that man is as susceptible as monkeys, fix the approximate lethal dose for man at 1 mgm. of dried poison.

(*f*) *Toxins*—

(1) Toxins operating on nerve cells:

(*a*) A depressor that paralyses the respiratory centre (Lamb, Rogers).

(*b*) A depressor that paralyses centres in the bulb. (Inferred from Lamb and Rogers and by clinical manifestations.)

(*c*) A depressor paralysing the ends of the phrenic nerves (Rogers).

(2) Toxins affecting the constitution of the blood:

(*a*) "Hæmolysin" destructive to erythrocytes (Rogers).

(3) Toxins destructive to other cells:

(*a*) "Hæmorrhagin" destructive to the intima of arterioles. (Inferred from *post mortem* changes, Elliot.)

(*g*) *Analysis of the toxic Action*—

(1) (*a*) The "neurotoxin" paralysing the respiratory centre is the predominent agent in causing death. Rogers shows that paralysis of this centre is complete before that of the phrenics is complete.

(*b*) The effects of the toxin operating on the centres in the bulb evokes a typical bulbar paralysis, affecting lips, tongue, throat, and voice.

(*c*) Contributes, but is a minor factor in the production of asphyxia.

(2) "Hæmolysin," by destroying the red blood cells, contributes to the asphyxia produced by (1) (*a*) and (1) (*c*).

(3) "Hæmorrhagin," by damaging the intima, allows leakage of the vessel contents and favours hæmorrhages.

(*h*) *Symptoms:* The action of the venom, as tested by experiment by both Lamb and Rogers, is found to be almost identical with cobra poison. The respiratory centre and the ends of the phrenic nerves are paralysed, and death supervenes from asphyxia. On the blood it has no action in reducing coagulability, but the red blood cells are destroyed as in other Colubrine poisonings. The local effects are sometimes marked; on the other hand, these have been so trivial in some reported cases that none could be discovered. Pain, at first absent, has sometimes later become a prominent symptom.

From the above one would expect to find the subject of krait poisoning suffering in almost the same manner as in cobra poisoning. One peculiarity, however, is very frequently reported, *i.e.*, violent abdominal pain.

The fact that Elliot found submucous hæmorrhagic spots in the stomach and intestines of all the monkeys he *post mortemed*, who died from experiment with this venom, taken in conjunction with the abdominal pain so frequently noted

in the human subject strongly suggests internal hæmorrhage. As shown when dealing with *Echis* toxæmia, internal hæmorrhages are by no means uncommon, and it may be that "hæmorrhagin" causes internal bleeding in this toxæmia in the human subject. In some cases indeed definite hæmorrhages have been reported, though the toxæmia appeared slight.

Acton and Knowles noticed in the subjects of their experiments that the degree of paresis in this form of toxæmia is more pronounced than in cobra poisoning, also that there was less tendency to convulsions towards the climax. Further, while in the cobra bitten subject, death or complete recovery occurs within 24 hours, the fatal issue in krait poisoning was in some cases much more protracted, in one case occurring after four days.

(*i*) *Illustrative Case* :* The details set forth here are the result of an interview I had with the deceased's friend, Mr. Chambers, who was with Mr. Fox when he was bitten, and subsequently the entire day until 7 P.M., when his condition was so serious that he was admitted to hospital. On February 26. 1914, Mr. Fox, a young middle-aged European in robust health, was bitten by a krait (*B. cæruleus*) † on the left wrist at about 10 A.M. in the Zoological Gardens, Calcutta. The snake was a half-grown one measuring 2 feet 3 inches, and the wounds inflicted consisted of 5 punctures. Mr. Fox was experimenting with a view to demonstrating the efficacy of a secret remedy in which he had every faith as an antidote for snake poisoning.

Symptoms : Instantaneous pain was complained of in the punctures, evidently of an unusual type, his own expression being that it was "fiery," and the wounds bled. Within one and a half minutes he had himself incised four of the five punctures with a lancet (which, I am informed, was quite clean and sterile, having been boiled and not used for any purpose subsequently). After incision the antidote, which was a fluid, was instilled into each wound. The fifth puncture was

* Published by me in the "Indian Medical Gazette" for July, 1914.
† The identification is unassailable.

overlooked. Within 5 minutes all local symptoms had disappeared, the "fiery" pain relieved, and bleeding had stopped.

Mr. Fox was not in the least degree alarmed, having implicit faith in his remedy.

Nothing further was noticed till about 2 P.M., when he complained of pain in the pit of the stomach, which he took to be stomach-ache and associated with his lunch. It was sufficiently disagreeable to cause him to take a "tot" of neat brandy, after which he had eructations, but this pain persisted until his admission to hospital. At 2.30 he said to his friend "I've got some slight symptoms" and when asked what these were he said he had "pins and needles" in his legs. He and his friend were walking about, and his friend began to notice that Mr. Fox tripped slightly, over little irregularities in the ground, as though intoxicated. This uncertainty of gait increased, and he next complained of nausea, which culminated in actual vomiting at 3.30 P.M. About 4 P.M. he complained that his vision was affected (but there was no sign of ptosis then noticed), and his gait was pronouncedly "drunken" in type.

About 5 P.M. drooping of the eyelids was distinctly evident. He next complained of "sore throat," and his speech was obviously affected. At 5.30 he sat down voluntarily, and it was noticed that his head drooped forwards. He complained that breathing was becoming difficult, and his eyes were now nearly closed.

His friend was now thoroughly alarmed in spite of Mr. Fox's sanguine composure, and took him to hospital where he arrived at about 7 P.M. When seen by Captain Green-Armytage, I.M.S., and Assistant Surgeon Warner, it was noticed that the patient was conscious, though apathetic and dull. He sat on the couch in a bowed posture, his head dropped forwards, and his arms limp and extended, his wrists and ankles dropped. He was unable to stand. His lower lip was dropped, and his speech thick and blurred. His face in the waning evening light appeared of a slate-gray pallor. He expressed a wish to be left alone, and complained of constriction and a feeling of swelling in the throat. He

had no anæsthesia, though numbness was a subjective symptom. His pulse was slow, full, and bounding, and his breathing similar to that of a diabetic coma patient. At a later stage he was unable to speak, his paralyses generally had increased, and he died at 8 P.M., ten hours after being bitten.

Treatment: He was ordered $\frac{1}{10}$ grain of strychnine hypodermically, and brandy internally.

Remarks: The case was a very typical one of Colubrine poisoning, and presented nothing but what was confirmatory of previously reported cases. Abdominal pain appears to be a characteristic feature of poisoning from the *cæruleus* venom, which is not specially evident, if evident at all in other Colubrine toxæmiæ. The only other cases of fatal krait bite known to me (two) died in twelve and five and a half hours respectively.

(*j*) *Treatment:* Antivenene is of no use against this poison and it would be waste of time administering it. The only thing one can do is to treat symptoms in the hope that the dose injected has been something sublethal. Above all look for syncope, and treat this vigorously. Many cases of snake-bite die from syncope that ought to be saved. Syncope is not a symptom of the toxæmia, but a complication due to fright.

Probably the best procedure is to inject Bayliss' fluid intravenously until the pulse is restored. This is composed of—

		Parts.
Gum arabic	..	7·0
Sodium chloride..	..	0·9
Water	.. ..	92·1
	=	100·0

This must, of course, be sterilized. If this is not ready to hand one Ampoule of Parke, Davis & Co's Pituitary (1 m.) should be injected hypodermically. Adrenalin is another

valuable agent. Either 5 to 30 m. of a 1 in 1,000 solution (Parke, Davis) may be placed beneath the tongue, or 10 m. to a pint of water may be used intravenously, if swallowing is not possible. As hæmorrhages are to be expected, they should be anticipated, and both pituitary and adrenalin, as advocated above, will be found as important for this as for syncope. Another useful agent to employ is chloride of calcium. One grain to 20 minims of water should be injected deeply into the gluteal muscles ; and repeated, if necessary, up to 3 grains.

The non-professional attendant can do much in such cases. He can subdue, if not actually relieve, pain by hot fomentations. He can apply friction with powdered ginger or mustard to various parts of the body in turn, whilst the rest of the body is covered up with blankets, and can pursue this course until eight or a dozen hot water bottles can be filled, when they should be wrapped in flannel garments or blankets, and applied all round the patient. He can give hot stimulating drinks, such as coffee, bovril, &c., if the patient can swallow. These should be given in small quantities (half a small coffee cupful or so) every ten minutes. Alcohol should not be given. He can further seek to gain the patient's confidence, allay his fears, and reassure him as to his fate.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures are longer than the rostro-internasals, and more than twice the rostro-labials. *Internasals:* The suture between them half to three-fifths that between the præfrontal pair, about two-thirds the internaso-præfrontals. *Præfrontals:* The suture between them longer than the præfronto-frontals ; touching the internasal, postnasal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures shorter than the fronto-parietals. *Nasals:* Equally deep. *Præocular:* Hardly reaching the top of the head. *Postoculars:* The lower rather the larger. *Temporal:* About as long as the supraocular. *Supralabials:* Seven ; the 1st and 2nd touching the nasals, 3rd and 4th the eye, and 5th and 6th the temporal ; first three subequal in length. *Sublinguals:* The posterior subequal to the anterior, touching the 4th infralabial. *Infralabials:* Four ; the 4th nearly as long as the posterior

sublinguals, but much broader than those shields; touching two scales behind.

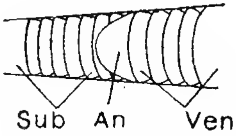

FIG. 83.—Anal region of Bungarus cæruleus.

Costals: Vertebrals, rather broader than long, rather broader than the ultimate row. Lateral scales, breadth about three-fourths their length. Ultimate row, scales about as broad as long. In 15 rows in the whole body length. *Ventrals:* 195 to 225. *Anal:* Entire. *Subcaudals:* 37 to 56.

(*b*) *Anomalies—Postoculars:* Rarely one. *Supralabials:* The second is rarely divided into an upper and a lower part. *Infralabials:* The 3rd as well as the 4th sometimes touch the posterior sublinguals. *Vertebrals:* Rarely some are divided, and the scale rows would count 17. This does not mean that there is a supernumerary row, and these parts of the vertebral should not, therefore, be counted as such. Rarely, however, a supernumerary row is seen above the third row from the ventrals for a variable distance along the anterior part of the body, and the scale rows are genuinely 17 in consequence. (Fig. 84.)

FIG. 84.—Two views of maxilla of Bungarus cæruleus.

Dentition.—*Maxillary:* Postnodal, 4. *Palatine:* 10 to 11. *Pterygoid:* 11. *Mandibular:* 15.

Distribution.—(*a*) *General:* Peninsular India and Ceylon.

(*b*) *Local:* In India it extends from Cape Comorin to the Himalayas, and is to be reckoned a common snake everywhere. In the north-west it reaches Sind, and in the north-east occurs up to about the longitude of Calcutta. It is a snake of the plains, but I have had it up to 5,000 feet at Almora in the Himalayas.

In Ceylon it is apparently a very rare snake. Haly refers to three specimens, one of which was from Jaffna. I have seen a specimen in the Colombo Museum labelled "Polgahawela," and I found a specimen among a small collection made by Mr. Carlos Beven, which he assured me was killed at Veyangoda. Mr. Drummond-Hay has never obtained a specimen.

BUNGARUS CEYLONICUS (Günther).

(Latin, implying pertaining to Ceylon.)

The Ceylon Krait.

Sinhalese: "Karawala" (Ferguson), "dunu-karawala" and "tel-karawala" (Willey).

Synonymy.—*Bungarus fasciatus.*

History.—First depicted in 1734 by Seba in his Thesaurus (Plate XLIII., Fig. 5). It escaped further notice until Günther referred to it in 1858.

General Characters.—This is the smallest of the eleven known kraits, attaining to about 3 feet in length. Head moderately depressed, short. Snout short, slightly declivous, without canthus, broadly rounded terminally. Eye small, like a black bead in life, the pupil indistinguishable. Nostril rather large, occupying the full depth of the suture between the nasal shields. Neck hardly constricted. Body cylindrical, moderately elongate and stout, of even calibre throughout, with lustrous scales. Belly rounded. Tail short, about one-tenth the total length, attenuating to a point.

Identification.—The ventrals are more numerous than in *cæruleus*, and the 2nd supralabial is shorter than the 3rd.

The colour, too, is very different. These points will differentiate it from such snakes as *Cercaspis carinatus*, *Lycodon striatus*, and *L. aulicus* to which it bears a superficial resemblance, the two former especially.

Colouration.—Shining black dorsally, with from 15 to 21 pure white bands round the body, and from 2 to 5 round the tail. These bars involve about two scales in the length of the snake vertebrally, and expand in the flanks, so that about four ventral shields are involved at midbody. They are broadest anteriorly and the first band may involve eight ventrals. The belly in adults is alternately black and white, the black intervals being broader than the white. In young specimens the belly is uniform white, and the posterior half of the head is white, with some sparse mottling, but this band entirely disappears with age.

Habits.—(*a*) *Haunts :* Haly says that it has an unpleasant habit of hiding itself amongst boxes in storerooms, stables, and in such like places. If its tastes are similar to those of its closest allies, one would expect it to take up quarters where other snakes are likely to be abundant, such as old masonry structures of every kind. Mr. Drummond-Hay dug one out of an ant-hill.

(*b*) *Disposition :* Mr. Green told me that a friend of his produced a box which contained a living snake of this species, which he had picked up, handled, and then placed in the box without being bitten. This singularly gentle spirit is quite in accord with what is known of the common Indian krait *B. cæruleus.*

(*c*) *Diurnal or Nocturnal :* There appear to be no observations made on this point, but the few casualties reported occurred at night.

Food.—I have removed snakes from the stomachs of two. One of these was a perfect *Rhinophis drummondhayi*, and the second a partially digested snake, the caudal extremity perfect, which also appeared to be a *Rhinophis* of the same species. The former was 256 mm. (10¼ inches) long, lying fully extended within the krait, which measured 495 mm. (1 foot 7¾ inches) long. The stomach of a third contained

masses of hair. The diet is seemingly the same as that of the Indian Krait, *i.e.*, usually snakes, but occasionally small mammals.

Breeding.—(*a*) *The Sexes:* I know of no superficial differences between the sexes. Of 15 sexed during my visit to Ceylon, 9 were males and 6 females.

(*b*) *Method of Reproduction:* Mr. Green's observations prove that it is oviparous.

(*c*) *Season:* The eggs referred to by Mr. Green were discovered in the month of January. Some had hatched out, and others were on the point of hatching. Some again were not nearly so advanced, leading one to suppose that two distinct broods were harboured in the same retreat.

(*d*) *Period of Gestation:* Not known.

(*e*) *Period of Incubation:* Not known. The parent or parents of the above were discovered with the eggs in a hollow in the earth, beneath a wood pile. They were unfortunately not sexed nor measured.

(*f*) *Number in Clutch:* The number of eggs in the clutch referred to above was not ascertained. The discoverer, however, in his narration of the facts to Mr. Green, said "there were lots of eggs and little snakes."

(*g*) *The Egg:* Mr. Green's observations were as follows: "The eggs have a soft leathery shell, and are lightly agglutinated together. They are cylindrical, with rounded ends, varying in length from 29 to 35 mm. with a breadth of 17 mm. ($1\frac{1}{8}$ to $1\frac{3}{8}$ inch by $\frac{5}{8}$ of an inch).

Growth.—(*a*) *The Hatchling:* The young measured by Mr. Green taped from 230 to 260 mm. ($9\frac{1}{16}$ to $10\frac{1}{4}$ inches). I investigated the egg-tooth of these specimens, and found a structure, somewhat resembling an inverted duck's head, fixed into the præmaxilla. The edge of the "beak" was horizontal in direction, and projected slightly beyond the snout. With this little structure the hatchling frees itself from its egg investment by a series of cuts. There is nothing determinate in the direction of these cuts, but they intersect one another at various angles, until a potential window has

been carved out, which yields on pressure from the baby snake's snout. The fœtal tooth, as it is called, drops out in those snakes where I have had an opportunity of examining it within a few hours of the attainment of liberty.

(*b*) *Early Life:* So few dates have accompanied the specimens I have seen that the rate of growth cannot be guessed at.

(*c*) *Maturity:* The age at which this snake is sexually mature is not known.

(*d*) *Maximum Length:* Boulenger gives this as 1,000 mm. (3 feet $3\frac{3}{4}$ inches), the tail 90 mm. ($3\frac{1}{2}$ inches). The largest I have seen was 890 mm. (2 feet 11 inches).

Poison.—(*a*) *Toxicity:* Very little precise knowledge is available. It has not been experimented with in the laboratory. Fatalities have been reported as a sequel to its bite, but this in itself does not prove that its bite is fatal. Deaths occur from the bites of harmless snakes. A good illustration of this is furnished under the remarks on *Oligodon arnensis*. It is much to be regretted that no well-reported case of a bite and its results is available from medical records. The few casualties reported have not been seen by medical men, and the accounts, therefore, lack that discrimination which only the medical profession can supply.

All one can say is that from analogy a fatal issue is likely to result from its bite, and it should be treated in life with the greatest care.

(*b*) *Symptoms:* These would be in all probability as detailed under *B. cæruleus*.

(*c*) *Illustrative Cases:* Dr. Willey records the case of a Malay woman in Colombo who was bitten during the night by this snake. It was killed and identified at the Colombo Museum. No symptoms were recorded. The woman was treated by a vedarala, but succumbed within twelve hours. Mr. Green has placed another case on record. A cooly was bitten in the foot at Gampola one night at 4 A.M. He killed the snake which was identified by Mr. Green. At 5.30 A.M. he felt sleepy and unwell, and would not attend muster. Drowsiness increased till 10 A.M. He was walked about until his legs refused to move. He was able to swallow very little

of the whisky that was offered him, and vomited after each dose. He became very cold, and finally died at 4 P.M., twelve hours after the accident.

It certainly seems highly probable from this account that the man was suffering from snake poisoning. The loss of power in his legs and his difficulty in swallowing accord well with the state of paralyses seen in other forms of Colubrine ophitoxæmiæ. Even if one admits that poisoning was manifest, it is impossible to know whether the death should be attributed to the action of the poison alone. The coldness referred to suggests a syncope, but as syncope is not a manifestation of Colubrine poisoning, one may be justified, perhaps, in ascribing it to fright, and cannot exclude this from the cause of death. There is no mention of respiratory embarrassment, the typical sequence, and actual cause of death in Colubrine ophitoxæmiæ.

(*d*) *Treatment:* Antivenene would be of no avail in the treatment of this toxæmia. However serious the case one should hope that the dose injected has been something sublethal and treat symptoms. Above all things do not let the patient die of syncope. Syncope is to be expected in every case of snake poisoning, look for it, and treat it vigorously, bearing in mind that it is not due to the poison itself.

The treatment should be as outlined for *B. cæruleus*.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures longer than the rostro-internasals, twice the rostro-labials. *Internasals:* The suture between them half that between the præfrontals, two-thirds the internaso-præfrontals. *Præfrontals:* The suture between them longer than the præfronto-frontals; touching the internasal, postnasal, præocular, and supraocular. *Frontal:* The fronto-supraoculars about three-fourths the fronto-parietals. *Supraoculars:* Length about four-fifths the frontal, breadth about half the frontal along a line connecting the centres of the eyes. *Nasals:* Both equally deep. *Præocular:* Barely reaching the top of the head. *Postoculars:* Lower rather larger. *Temporal:* As long as the supraocular. *Supralabials:* Seven; the 1st and 2nd touching the nasals, 2nd shorter than the 1st or 3rd; the 3rd and 4th touching the eye; and the 5th and 6th touching

the temporal. *Sublinguals:* The posterior subequal to the anterior; touching the 4th infralabial. *Infralabials:* Four; the 4th broader than the posterior sublinguals, and about as long as those shields; touching two scales behind. (Fig. 85.)

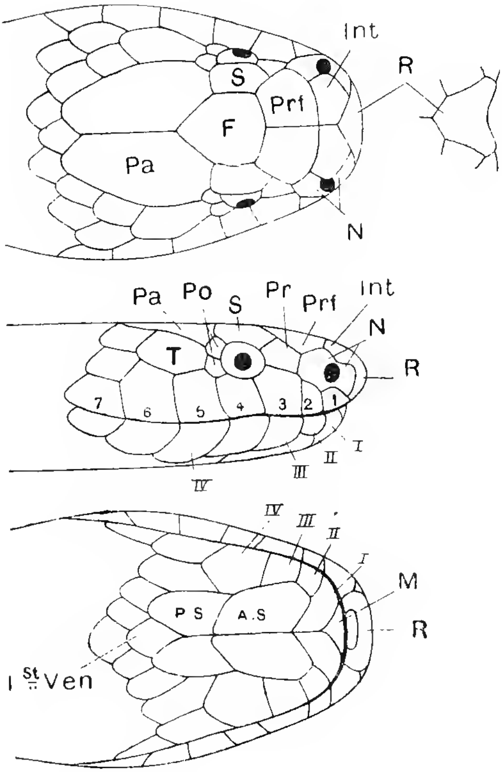

FIG. 85.—Bungarus ceylonicus.
(× 3.)

Costals: Vertebrals broader than long, broader than the last row. Ultimate row. Scales as broad as long. In 15 rows in the whole body length. *Ventrals:* 219 to 236 (♂ 219 to 229, ♀ 230 to 236). *Anal:* Entire. *Subcaudals:* 32 to 40 (♂ 35 to 40, ♀ 34 to 37).

(*b*) *Anomalies—Postocular:* Rarely one. *Supralabials:* The 2nd and 3rd very rarely confluent. *Infralabials:* The 3rd as well as the 4th sometimes touching the posterior sublinguals.

Dentition.—From four skulls in my collection. *Maxillary:* Postnodal, 3. *Palatine*: 11 to 12. *Pterygoid:* 8 to 10. *Mandibular*: 15 to 17. (Fig 86.)

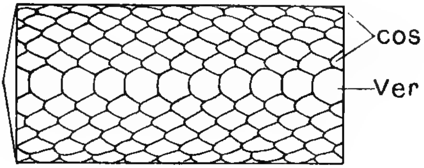

FIG. 86.—Scales of B. ceylonicus seen from above. (× 2.)

Distribution.—(*a*) *General:* Peculiar to Ceylon.

(*b*) *Local:* It occurs in the low-country, but appears to be a rare snake there. Willey says it occurs chiefly up-country, and mentions Peradeniya, Dimbula, and Balangoda. Some of my specimens came from Peradeniya, Kalupahani, Haldummulle district (3,000 feet), and Kandy, but the locality of most was not specified. Mr. Drummond-Hay informs me that he found it common at Lennock, Balangoda district (3,000 to 4,200 feet), and also at Punagalla, Yatiyantota district, below 3,000 feet.

Genus NAIA.

(A latinized form of Naja, which is probably corrupted from the vernacular "nag.")

General Characters (from Indian species).—The species vary from about 6 to 15 feet in length. Head markedly depressed, swollen behind the eye over the poison glands. Snout short, slightly declivous, with obtuse canthus, narrowing terminally. Eye moderate in size, lateral, with round pupil. Nostril rather large, lateral, occupying the whole depth of the suture between the nasals. Neck fairly evident. Body

rather short, stout, rather depressed; with a shallow furrow along the spine; dilatable anteriorly into the so-called hood, attenuating posteriorly. Belly rounded. Tail moderate in length, being about one-fourth to one-ninth the total length.

Identification.—The following syndrome will, I think, distinguish the genus among Asiatic snakes. Vertebrals rectiform, not enlarged; the breadth of its scales about half their length. Last two or three rows rectiform; the intermediate rows oblique. Last row enlarged, and its scales as broad as long. All the rows smooth.

Habits.—Terrestrial. Diurnal. Active. Fierce when provoked.

Food.—Mammals, birds, reptiles, and batrachians.

Breeding.—Oviparous.

Poison.—Very virulent. Usually fatal to man.

Lepidosis.—*Rostral:* Touches six shields. *Internasals:* A pair. *Præfrontals:* A pair. *Frontal:* Touches six shields. *Nasals:* Divided. *Loreal:* Absent. *Præocular:* One; barely reaching the top of the head. *Postoculars:* Three. *Temporals:* Two. *Supralabials:* Seven; the third touching the postnasal and the eye. *Sublinguals:* Two pairs. *Infralabials*. Five. *Cuneate:* Present or absent.

Costals: Longer than broad; smooth; without apical pits or facets. Vertebrals and last three rows rectiform, the intermediate rows oblique. Vertebrals not enlarged. Last three rows increasing in breadth. Ultimate row broadest. In from 15 to 25 rows in midbody. *Ventrals:* Rounded. *Anal:* Entire. *Supracaudals:* In even rows. *Subcaudals:* Divided.

Dentition.—*Maxillary:* Postnodal, 1 to 3; isodont. *Palatine:* Anododont, scaphiodont. *Pterygoid:* Anododont, isodont, or feebly scaphiodont; posterior two-thirds edentulous. *Mandibular:* Anododont, kumatodont. The maxillary and mandibular have shallow grooves on the outer faces, and the palatine and pterygoid on their inner faces.

Distribution.—Africa and South Asia. There are ten species, seven of which are African, and three Asian. One is peculiar to the Philippines, and two inhabit India. Only one occurs in Ceylon, viz., *tripudians*.

NAIA TRIPUDIANS (Merrem).

(Latin, "tripudio" I dance on the toe.)

The Cobra.

Tamil : "Nalla pambu" (good snake) and "naga pambu." *Sinhalese :* "naya" (Ferguson).

Synonymy.—*Coluber naia, C. cæcus, C. rufus, C. peruvii, C. brasiliæ, Naja lutescens, N. fasciata, N. brasiliensis, N. siamensis, N. maculata, N. nonnaja, N. kaouthia, N. larvata, N. atra, N. oxiana, Vipera naja, Elaps fuscus.*

History.—Depicted by Seba in 1734 (I., Plate XLIV.), and again in 1735 (II., Plates LXXXIX. and XCVII.), then by Linné in 1754 and 1767. Later in 1768 Laurenti referred to it. Russell figured it twice in his first volume (Plates V. and VI.) in 1796, and again in his second volume (Plates I. and XXXVI.) in 1801.

General Characters.—Grows to about 6 or 7 feet. Head strongly depressed, broad behind the eyes, swollen over the poison glands. Snout short, slightly declivous, with obtuse canthus, rounded terminally. Eye moderate, with iris more or less speckled with gold. Nostril rather large, open. Neck fairly evident. The forebody remarkably dilatable to form the hood. Body depressed, with shallow groove down the spine, attenuating somewhat to the vent. Belly rounded. Tail cylindrical, accounting for about one-fifth to one-ninth the total length.

Identification.—The contact of the præocular shield with the internasal in front and the eye behind is one infallible method of recognizing it. Another is the presence of the little cuneate scale wedged between the 4th and 5th infralabials. This is, however, rarely absent. A third way is to count the costal rows. If 27, 25, or 23 two heads-lengths behind the head, 25 or 23 at midbody, 17 or 15 two heads-lengths before the vent, and the loreal is absent, there can be no doubt as to its identity.

If a typical hood mark is present, either of the monocellate or binocellate type, the diagnosis is also easy, but in many

specimens there is no hood mark at all, and in death *rigor mortis* stiffens the joints so that the hood is not easily demonstrable. It is for this reason that attention to shield characters is recommended. If the hood is seen dilated in life, there should not be any doubt about the snake, but it must be remembered that other snakes flatten the neck though to a more limited degree. The cobra has been confused by Europeans and natives with *Zamenis fasciolatus*, a snake that occurs in Ceylon.

Colouration.—As far as I am aware, variety *typica* is the only form found in Ceylon. This is a uniform pale or dark brown dorsally, or is dappled or variegated with wheat colour, and brown or dun. The variegations in many specimens tend to form indistinct cross-bars. There is a well-defined spectacle-mark on the hood and a black spot on a white ground on each side below the hood. The spectacle is a white mark on the hood which may be very perfect, and encloses a black spot or sometimes two on each side. It is frequently more or less disintegrate, and occasionally completely absent. Mr. Green has written to me of such a specimen. The central area of the hood in some examples is reddish, and in others smoky brown. The belly is more or less mottled with buff and various shades of dun or brown, and beneath the hood there are very generally two, sometimes more, dark bands of brown or blackish. The throat and chin are frequently yellowish. The head is olive-brown, with the sutures blackish, and there is in many specimens a blackish ring round the eye, and a fine subocular streak of the same colour. Mr. Green tells me he has never seen a blackish specimen in Ceylon, but Abercromby mentions such.

Habits.—(*a*) *Haunts:* The cobra may be found almost anywhere. I have encountered it in heavy jungle, and in open country far removed from forest growth. The ryot disturbs it in his crops, the mali in cantonment gardens, and the sportsman when shooting. It is a common snake in almost every populated area, and I have had it sent to me frequently from within cantonment limits, from the regimental and other bazaars, from Artillery and other lines, the suburbs, and actually in the gardens of our largest towns, from inside

jails, the godowns of the Supply and Transport Corps, and the Telegraph Departments, from warehouses, and various mills, and such like situations. No amount of bustle or disturbance seems to deter it from taking up its abode in man's immediate vicinity. It was sent in to me several times in Rangoon from timber yards, where hundreds of men were working daily, elephants pounding up and down moving timber, engines vibrating and throbbing, and circular saws screeching through boles of teak. Even in such scenes of turmoil it will establish itself beneath a stack of wood, or convenient drain, and escape dislodgment for long periods.

Old masonry invariably harbours cobras among other snakes. In Delhi the old walls of the Fort were always a safe draw for the snakeman, whom I saw every week bring in his bag—some half dozen or more—to be robbed of their poison, which was being collected for the Government of India. Similarly, old cemeteries and ruined habitations, mosques, &c., furnish ideal quarters for this snake. Another favourite haunt is the loose brickwork of old wells. The basements of many houses in cantonments and bazaars can boast a cobra tenant, and it is not surprising therefore that this snake is so frequently encountered inside bathrooms, and dwelling rooms, besides stables and servant's habitations. Further afield an ant's nest is often a specially favoured resort, or it may be any hole in the ground, or at the basement of a tree among its roots. It is frequently found near water, and often actually in that element, in which it swims with facility and strength.

A few cases of cobras climbing trees are reported, the object usually being the plunder of some birds' nest.

It has been occasionally reported in the sea, perhaps carried thence by rivers in flood time, but sometimes, no river being in the vicinity, it must have taken to the sea of its own free will. In one instance, a 4-footer is said to have managed to board a man-of-war, viz., the "Wellington," lying off the coast of Ceylon at Aripo. Another account of the incident, however, says that the sailors saw the snake in the sea swimming vigorously towards the ship, and assailed it so successfully with billets of wood and other missiles that it returned to land.

Bassett Smith mentions one 14 inches long trying to board the flagship at Trincomalee when lying out about half a mile from land.

(*b*) *Disposition:* The cobra is usually not an aggressive snake. When flushed in its native haunts, it nearly always tries to escape, and usually succeeds in doing so, but is often shot before it gets to a place of safety. I have encountered many, and find that at close quarters, if suddenly disturbed, or it may be if stepped upon, it quickly erects itself, hisses loudly, sways backwards and forwards, and awaits an opportunity to strike. If one keeps still, the menace is quickly over, and the snake drops its head, and slinks off. An incautious movement, however, causes it to turn, erect itself once more, and challenge the intruder again. Many good observers have remarked on its timid nature. Mr. Phipson even went so far as to describe it as an exceedingly timid snake. Elliot says: "Of one thing I feel certain, the cobra is a timid snake, that it is not at all inclined to bite, and unless assailed, and so infuriated, will not bite, even if trodden on by accident so long as the snake is not hurt." He cites two cases known to him where a cobra was actually stepped on, but in neither case did it inflict a bite. Wall (A. J.) remarks that a full-grown cobra can be handled with perfect safety, and Flower mentions one that was picked up in his garden by a servant, and brought to him alive not having attempted to bite him.

In Chitral one day an adult passed right through my pony's legs, whilst I was walking along the road with another mounted officer. The snake did not even erect itself though in danger of being trodden upon, but glided through the pony's feet, and then, when three or four yards distant, turned, half erected itself for a second, and then glided off down a bank. I could quote many more incidents and opinions illustrating the unaggressive temper of this snake, but, on the other hand, I have certainly witnessed many incidents of a completely contrary character. The cobra is sometimes very fierce, and when disturbed may be a very dangerous snake to encounter. Whatever spirit and aggressiveness may be natural to it in the early days of captivity, I think all will agree that it is very easily tamed. This is evident to anyone who has

seen jugglers and professional snakemen with their captive specimens. If a specimen has been on show for long, it will often require a good slap on its back to provoke it to erect itself and hiss. The cobra that will do so without such treatment, one may depend upon it has been but recently deprived of its liberty.

Young cobras are much more dangerous than adults, as a rule. They seem more on the alert, more easily excited, and strike repeatedly and with much malice. Wall (A. J.) speaks in similar terms when he says : " When the young cobra is hatched, it is very small, very irritable, and exceedingly dangerous. A full-grown cobra can be handled with perfect safety, but a young one, ten or eleven inches long, is so active, and its body is so small, that it can be scarcely touched with impunity." It is certainly significant that one never sees a young cobra in the hands of jugglers.

(*c*) *Striking Posture :* The most notable habit in the cobra is the very remarkable pose it adopts when alarmed, and which has gained for it world-wide renown. Not only does it erect the forebody to a remarkable degree, but it flattens its neck in a very remarkable and characteristic way to form the so-called " hood." The height to which a cobra can erect itself is usually very much over-estimated by the casual observer. I have taken careful measurements on several occasions, marking off the height on a stick, when the snake's attention was engaged by a juggler. The measurement of the whole snake in life is not easy, and the lengths given must not be taken as very exact. I found the degree of erection commensurate with the degree of excitement or provocation. One snake measuring 5 feet 2½ inches poised vertically to a height of 13 inches, another 5 feet 4 inches long sat up 15½ inches, a third 6 feet and ½ an inch raised itself 14 inches, and a fourth 5 feet 1 inch, only 7½ inches. On August 20, 1904, in Bangalore I found a 5-footer just sat up 15 inches, but on the next day in the presence of a mongoose that was causing him much agitation the same snake erected itself 21 inches. Another cobra 1½ inches less in length raised itself just 21 inches under similar provocation. It may be taken then that the maximum limit of erection is about one-third the length of the snake.

The so-called "hood" is formed by the action of muscles operating upon the ribs in the region behind the neck. I have examined a skeleton in the Museum of the Royal College of Surgeons, London, which is well set up in the erect position, and with the ribs fixed as they would be in the expanded hood in life. The atlas (1st vertebra), axis (2nd vertebra), and the 3rd vertebra have no ribs, but the 3rd has an elongate rib-like transverse process. The succeeding 27 vertebræ have ribs attached to them that are involved in the production of the hood. These ribs are much less bowed than those in the rest of the body, and enjoy a range of movement greatly in excess of the other corporeal ribs. The 9th is the longest on the left side, and measures 41 mm., and the 10th measuring 42 mm. is the longest on the right side. The preceding and succeeding ribs progressively diminish, so that an oval outline is given to the hood. The ribs are set obliquely, forming an angle of 40° to 45° with the long axis of the spine. In the prone state they are directed backwards, outwards, and downwards, and give a contour to the body almost like that in other parts. In the erect pose the corresponding direction of the ribs would be downwards, outwards, and forwards, but any forward tendency is entirely obliterated by the action of a set of dorsal muscles that not only draw the ribs back till they are completely transverse, but also fully straightens them. During full expansion, judging from a freshly dissected hood, I think the ribs are also slightly elevated, and the angle made with the spine thereby rather increased. As the overlying skin is but loosely attached, it does not in any way hamper the movements of the ribs within, which by their backward extension and elevation enormously stretch it in a lateral direction, at the expense of the ventro-vertebral diameter. The oval shape of the hood and the flattening produced has been well compared to a shallow spoon or skimmer. The hood originates high up in the nape, and the head bent strongly at the atlas joint is carried at right angles to it when spread. The arching of the forebody, and general pose and movement of the cobra, when erect, remind one very forcibly of the carriage of a swan's neck. The dorsal skin is very much stretched when the hood is expanded, so that

the scale rows are widely separated, and as the hood marks are almost entirely confined to the skin, they become very conspicuous. The curious poise adopted can be sustained for a considerable time, certainly many minutes if sufficient stimulus is offered and continued. Whilst poised with expanded hood the snake sways restlessly forwards and backwards, and can be made to bend backwards to an extraordinary degree before losing its equilibrium. It hisses in a fierce explosive manner whilst erect, and I have carefully observed caged specimens at this time. I noticed that hissing occurs both during inspiration and expiration. The inspiratory is the shorter act, and its note higher pitched than the expiratory. It is quavering in quality, reminding one of a knife on a grindstone. The expiratory effort is the longer, louder, and lower-pitched, and intermittently explosive in character. The tongue is emitted during both inspiration and expiration. The throat is very distinctly pouched during both acts, but is far more marked during expiration. The inflation extends as far forwards as the chin shields. Whilst erect the snake inflates its body independently of its hood action, and the inflation affects nearly the whole body length, declining posteriorly till finally lost a few inches before the vent in an adult.

The cobra's effective striking range is a very limited one. I believe the erection of its forebody and the expansion of its hood are invariable preliminaries, and the height to which it can erect itself forms the radius of its stroke. This radius when the snake is erect is very deceptive, appearing much greater than it proves to be when measured along the ground on the completion of its stroke. Jugglers from long practice estimate this range wonderfully, and contrive to evade their captive's menace, with remarkable precision, withdrawing their hands, often only a few inches, from the spot where the stroke is delivered.

The bite is often a mere snap of the jaws, and the bitten part immediately released, but sometimes the snake will fasten itself tenaciously, necessitating a forcible opening of the jaws to effect release. Mr. Donaghy told me of an incident witnessed by him where a young sampwalla was bitten, and the

snake hung on to him so that it had to be removed by forcibly prizing open the jaws. Sometimes after a bite a drop or more of venom may be seen on the skin of the bitten subject which may be wiped off without gaining access to the punctures inflicted. More rarely poison is shaken off in the form of a spray or jet by the forcible thrust forward of the snake, which may fail to reach the object of its attack.

I have on more than one occasion witnessed this with jugglers who unconcernedly wiped away the poison emitted. In the Bombay Natural History Journal* Mr. Goring Jones reported a cobra at Mandalay striking at Lieut. Gibson who was bending down near the snake. He was not actually struck, but had poison ejected into his eye, much swelling and pain following. A hospital assistant of mine, whilst trying to dislodge a cobra that had taken refuge in the wall of his garden, had a jet of poison ejected into his face. Mr. Kinnear tells me that in our Society's rooms it is a matter of common observation that cobras "spit" at spectators and leave a spray on the glass. One may presume that some such incident caused Boie to christen one variety of our Indian cobra *sputatrix* (spitter). The habit is well known among certain African cobras, notably *N. flava*, *N. nigricollis*, and perhaps *N. melanoleuca*.† I believe the venom ejected is shaken off the fangs, and carried forward by the vehemence of the thrust. In some instances, however, where a shower of spray is reported it is more probably caused by the explosive expiratory blasts from the glottis, which occur while the snake is hissing, and to which I refer again later.

(*d*) *Nocturnal or Diurnal:* This species is diurnal in habit. I have several times witnessed one in hilly country, where I could look down upon it, without being observed, and noticed the stealthy way it probed into every recess or clump of vegetation that might conceal a quarry consistent with its gastronomic tastes. I have several times met one when birds' nesting, shooting, or out after butterflies. Many of these were obviously not roused from a siesta, but were

* Vol. XIII., p. 376.

† The spitting snake of South Africa is usually admitted to be *Sepedon hæmachates*, the "ringhals" of the Dutch.

roaming about, I suppose, in search of food or drink. In populated areas it is perhaps more frequently encountered at night. Mr. Hampton tells me his captive specimens did not usually show themselves until midday, or the early afternoon, and remained out till about 10 P.M.

(*e*) *Progression:* It moves with wonderful alacrity when it has once decided to quit some possible danger confronting it. Young specimens especially move most expeditiously, and are wonderfully adroit in avoiding capture or despatch.

(*f*) *Hearing:* One of the most interesting matters in connection with the cobra affects that ever fruitful subject of discussion "charming." It is clear that many very competent authorities disbelieve in the practice. Mr. Phipson says: "It is the constant movement of the musical instrument in front of the snake that keeps it erect and not the noise produced," and this is precisely what many other good observers state. I certainly take this view myself, and came to this conclusion very early in my Indian career. One thing puzzled me at first and aroused my suspicion, viz., why is it that in all the stories one reads of "charming," it is invariably the cobra that withdraws from its snug retreat, whilst other snakes apparently are not susceptible to the captivating (?) sounds of the juggler's pipe? I know of no anatomical difference in the auditory apparatus of cobras from other snakes. I experimented frequently in Delhi in my verandah with cobras. I cut narrow strips of sticking plaster, sufficiently broad to cover the eyes completely. These strips had a double purpose. Not only did they blindfold the subjects of experiment, but being carried right round the head they locked the snake's jaws, and so prevented any chance of my being bitten. This done the snake was released, and in a very short time it relaxed its hood, and assumed a completely recumbent attitude. The verandah in which the first of these experiments was carried out was a crazy wooden structure, and if one moved a chair, or even if a servant walked along the room inside, the snake immediately erected itself as if conscious of danger. On the cement verandah downstairs, it was also noticed that the snakes immediately got up when

any one walked along in the near neighbourhood. I had a kerosine oil tin at hand, and when the snakes were recumbent I beat this with a stick close to their heads without their taking any notice whatever. Similarly, I blew a bugle close beside them, but they were not charmed! The greatest care is necessary in conducting such experiments to eliminate all other possible means of rousing the snake. For instance, if a rusty tin is beaten over the snake, particles will fall on it and rouse it to attention. Similarly, if the blast of air emitted from the bugle, impinges ever so little on the snake, it is roused to action and erects itself.

Many people suppose that a snake is deaf, but this is not the case. Snakes hear well, though they have no external ears. Many people are not aware that there are two ways in which the essential auditory apparatus may be stimulated and sounds heard. If one strikes a tuning fork, and places the stem on any part of the skull, or even the spine to its lowest part, the vibrations can be heard distinctly. If the head is in contact with a table, and the tuning fork struck, the sound is audible when the stem is placed on the table at some distance though inaudible when not touching the table. This is due to the conduction of vibrations through solids, and such vibrations are better heard and for a longer time, than those conducted by waves of air, which strike upon a membrane (the drum), situated at varying depths (according to the particular animal) in a canal in the skull (the external auditory meatus). The drum set vibrating acts through a chain of tiny bones in the middle ear, so as to affect fluid contained in semi-circular canals in the internal ear, the fluid in its turn communicating the vibrations to highly specialized sense organs at the termination of the filaments of the auditory nerves. These nerves carry the impulses received to the brain centres, where they are interpreted as sounds. This latter method of conduction, viz., by means of the air, is the predominating one in mammals, birds, and many reptiles, but is entirely wanting in all snakes, there being no external orifice, and no drum to receive impressions. Conduction by solids is, however, good in snakes, perhaps for all we know more highly sensitive than in man.

Now, it is obvious that if snakes have no ear openings and no drums they cannot hear sounds conducted by air, such as those emitted by musical and other instruments. This accounts for the cobras taking no notice of the noises I made at close quarters, though they were keenly alive to sounds such as footsteps communicated through the ground. If one is to believe the wonderful stories, told in good faith I have no doubt, about "charming," one must explain it by assuming that snake charmers are possessed of some occult force not apparent to the spectators, for it cannot be explained through the agency of sound conducted by air. As a matter of fact, a snake charmer in Bangalore, with whom I had become very familiar, admitted to me that snakemen knew that snakes were deaf, and that the whole of their "charming" was a hoax. It is most certainly the incessant movements of the man's arms while piping, or the restless movements of his knees while squatting, that affords the necessary stimulus, and keeps the cobra excited and erect.

It is very curious how all absorbing movement is to the cobra. Mr. Phipson says: "You have only to attract its attention with one hand, while you seize it in the middle of the body with the other and the snake is yours. It strikes in every direction, *especially at any moving object*, but it never seems to occur to it to turn, and bite the hand that is holding it as almost all other snakes would do at once." I fully agree with all Mr. Phipson says on this subject, and consider this strange trait argues a very great lack of intelligence.

(*g*) *Hissing:* This has been already remarked upon under "striking posture."

(*h*) *Sloughing:* Fayrer mentions a cobra that cast its skin on October 17, and again on November 10 and December 7. Another in his possession desquamated on October 15 and on November 6. In Trivandrum* a captive cobra shed its skin on November 10, 1902, and on February 19, April 8, and July 28, in 1903. I have been told by snakemen that ecdysis occurs about once a month, and Vincent Richards gives about the same period between successive moults from his observations. It will be seen from the above that there is no regularity

* *The Field,* April 16, 1904.

in this function, which may occur at intervals ranging between three weeks and three months. I am informed by snakemen that specimens in captivity sicken during this period, and that they are afraid to give them food or drink as it upsets them. They certainly appear very dull, and non-captive specimens are most likely to meet with their death, if they venture out of their holes at this time, the disc before the eye becoming so opaque that the creature is virtually blind for some time.

Food.—The cobra feeds principally on rats, frogs, toads, and less frequently on birds, and it seems to show no special preference for any of these creatures. Its choice in batrachians is largely determined by their size, the most bulky individuals being apparantly those most sought after. Thus, among frogs it is the bullfrog, *Rana tigrina*, which is most usually victimized, and among toads *Bufo melanostictus* and *B. andersoni* are specially attractive. Rats and mice are very frequently taken, and I think there can be no doubt the numbers of these vermin are materially checked by this snake. I was astonished in Bangalore some years back to see with what avidity the captive cobra, belonging to a juggler, accepted dead mice which he withdrew from his pocket. The man offered them as one would a morsel to a dog, and one of his cobras nosed its snout into his hand, and took three mice, swallowing them one after another in a couple of minutes or so. Other creatures are taken as circumstances dictate. The Rev. C. Leigh, S.J., writing from Trichonopoly of his captive specimens, told me that after eating two small frogs, and then three middle-sized ones, one cobra finally disposed of two squirrels (*Funambulus palmarum*) ! Sometimes birds are attacked and killed, especially poultry. In Fyzabad one got under a hencoop one night in a native hut, and killed the hen and six chicks. The snake met its death the next night, swallowing a frog baited on a hook. On another occasion one got into a quailery in Fyzabad and accounted for thirteen birds in the night. One only of these had been swallowed, and it seems to me likely that some or all the rest may have died from fright. In Almora an officer friend of mine, whilst quail shooting flushed a cobra which he shot in attempting to escape down a hole.

The snake was cut in half by the shot and a freshly swallowed quail fell out of the stomach. Ferguson* mentions one that was brought in to him at Trivandrum enormously distended. It measured 4 feet and contained a monitor lizard (*Varanus bengalensis*) 2 feet long. Phipson mentions lizards being taken by the young in our Society's rooms. Occasionally the cobra exhibits ophiophagous tastes. Mr. Millard tells me that one in our Society's rooms ate another with which it was caged, both snakes having seized the same frog, and commenced eating from opposite ends. On another occasion one was observed to eat a wolf-snake (*Lycodon aulicus*), Mr. Frere recently sent me a young example measuring 14½ inches, that was eating a *Lycodon aulicus* measuring 13½ inches. I saw one once, in a well in Trichinopoly, in the act of devouring a cat snake (*Dipsadomorphus trigonatus*). Colonel G. H. Evans found one in Burma eating a young snake of the genus *Simotes*. Mr. Kinlock wrote to me of one he encountered at Kil Kotagiri. It measured 5 feet 7 inches, and was engulfing a dhaman (*Zaocys mucosus*) 6 feet long. Flower again mentions one in Siam swallowing a snake (*Macropisthodon rhodomelas*). Here I may mention that the cobra itself sometimes falls a victim to its larger and more confirmed ophiophagous relative, the King cobra (*Naia bungarus*).

Some interesting accounts have appeared of cobras eating the eggs of poultry. Mr. C. P. George recovered the egg of a guinea fowl from a cobra's interior, which he set and, in due course, hatched out! Miss Hopley in her book on snakes (p. 60) records an exactly parallel incident. In this case, however, the egg was a hen's. It was marked after extraction, and placed under a guinea fowl, and successfully incubated. Mr. Brook Fox records a cobra that had got into a guinea fowl's nest, and had eaten six of the fifteen eggs. It was photographed in this state. The eggs were subsequently removed and set, and three eventually hatched out. After the publishing of these events Colonel Bannerman experimented on cobras in the Parel Laboratory to ascertain how long it took for the egg shell to dissolve under the influence of the

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* Vol. X., p. 75.

gastric juices, and he found that it required about 48 hours. Inspection of the subsequent excrements showed in one case that a few pieces of egg shell were discharged sixteen days after the experiment.

In captivity many specimens feed eagerly, and thrive well. Mr. Phipson wrote that those in the Society's rooms "fed freely on rats, birds, and toads." Similarly, Ferguson said those at Trivandrum took large frogs "with avidity." The Rev. C. Leigh wrote to me that one of his captive specimens ate "rats with relish," and two others "took frogs with avidity." On the other hand, Dr. Nicholson speaking of cobras in captivity says: "I have never seen a cobra feed, and I think that unless fed by force he will starve himself to death." This statement coming from such an authority is remarkable, but it would appear from the methods of some professional snakemen that they, too, find some of their specimens difficult to tempt with food, for many carry with them a small natural funnel, which appears to be part of the shaft of the tibia of a goat, which they insert into some cobras' throats, and into which they break a fowl's egg or pour milk.

Thirst: Like other snakes it suffers from thirst, specially in the hot weather, and I daresay that many of its intrusions into bathrooms and its lodgment in catch-pits and wells may be accounted for in this manner. I saw one in the possession of a snakeman in Cannanore that dipped its head into a tin of water presented to it and drank greedily; each gulp being plainly visible in the throat.

Breeding.—(*a*) *The Sexes:* The cobra seems to show a decided tendency to a social life. Many writers have remarked upon its habit of living in couples, and this is specially true during the breeding season. It appears, however, to seek society apart from sexual impulses, for on one occasion in Rangoon two were brought to me found coiled together beneath a stack of wood, and both proved to be females. On another occasion, also in Rangoon, a Burman dug out a hole where he had seen a snake make good its escape. The result was the discovery of three cobras. Two of these were males, and one a female which showed ovarian follicles, obviously fertilized and enlarged. This leads one to ask the question

does the cobra on occasion practise polyandry? Mr. Fitzgerald once told me that he saw three large snakes go into a hole in his compound within a few minutes. He had possessed himself of his gun, as speedily as possible, and shot the third snake before it had quite disappeared, and this proved to be a cobra. He assumed the others to have been of the same species, but, unfortunately, did not verify his suspicions.

I can discover no difference in the lepidosis of the sexes, nor in the relative lengths of the tails. There is no constant difference either in the ranges of ventrals and subcaudals. The male clasper is narrow and long and surmounted with very small claw-like tentacles. It is not bifid. Females appear to be more numerous than males in Bangalore, as Dr. Nicholson found 410 of the former, against 308 of the latter, in 718 cobras sexed by him. In Cannanore, however, I got eight males to a single female. In Chitral out of 18 sexed, 11 were females and 7 males. In Fyzabad I collected 18 males to 15 females.

(b) *The Act of Mating:* Colonel Dawson had captive cobras in Trivandrum which were observed "in copula" in January. Mr. H. Hampton wrote to me of a pair he had in captivity in Burma that were observed in the act of mating at the end of March. Mr. Foulkes told me of a pair he found coupled in June at Rajamundry.

The act of mating has been witnessed by Colonel Dawson and Mr. H. Hampton, to whom I am indebted for the following details: In Trivandrum the pair remained coupled from 11 A.M. until 4.20 P.M. on January 17. In Mr. Hampton's vivarium coitus lasted intermittently for three days. He observed that the pair nodded their heads continually, and their bodies quivered. They did not take the slightest notice of anybody in front of their cage. They did not expand their hoods, neither did they wrap themselves around one another. Each turned the vent upwards and sideways to effect engagement.

(c) *Method of Reproduction:* Eggs are produced by the cobra.

(d) *Season:* Flower in Siam had a gravid female with eggs fit for discharge, judging from their measurements, in the

month of January. Nicholson had several gravid females with eggs about an inch long in February at Bangalore, and I had one in a similar condition at Cannanore in the same month. Mr. E. E. Green also had a gravid female in Ceylon in February. Evans and I obtained gravid females in Rangoon in July and August, one specimen in July showing but little enlargement of the ovarian follicles.

The usual months for the deposition of eggs are April and May. Four cobras laid eggs in the Parel Laboratory in April, and eight in May. Nicholson says that about Bangalore they are laid in May and early June. Mr. Phipson remarked that eggs are laid in the rains. Two eggs sent to me from our Society's collection were deposited in June. Wall (A. J.) mentions eggs laid in July, and Hampton's eggs were laid in the middle of August at Mogok, Burma.

(*e*) *Period of Gestation :* The period of gestation is accurately known in Colonel Dawson's case. Sixty-two days after coitus, *i.e.*, on March 20, eight eggs were deposited, the first at 8 A.M., six more almost immediately, and then after the lapse of half an hour the last. In Mr. Hampton's case the mating was observed towards the end of March, and eggs were not deposited until the middle of August, nearly five months.

(*f*) *Period of Incubation :* Fayrer says, on the evidence of his snakemen, that the cobra incubates her eggs, and that they frequently dug out mother and brood. This is in accordance with the habits of other snakes, and receives direct confirmation from Colonel Dawson, who told me that at first his dam coiled herself among her eggs. The period of incubation has been ascertained at Parel. Eggs laid on May 12 hatched out on July 20, *i.e.*, in sixty-nine days. The period that elapses then between coition and the advent of the young is rather over four months.

(*g*) *The Eggs :* From over a dozen records, I find that the usual number of eggs laid is 12 to 22. I find one record of 8, and the only record of over 22 is Mr. Hampton's. In this case 45 eggs were deposited, 36 seemingly good, and 9 apparently infertile.

The eggs are elongate white ovals, with soft shells and similar poles. The two sent me from the Bombay Natural History Society measure 49 × 28 mm. (a shade under 2 inches in length). The almost mature eggs extracted from the maternal abdomen by Flower measured 53 × 34 mm. Eggs sent me from Parel vary much and are much smaller, and it occurs to me they may have been infertile. Two of these measured 41 × 20 mm. ($1\frac{5}{8} \times \frac{3}{4}$ of an inch), one 38 × 19 mm. ($1\frac{1}{2} \times \frac{3}{4}$ of an inch), one 32 × 20 mm. ($1\frac{1}{4} \times \frac{3}{4}$ of an inch), and a fifth 29 × 15 mm. ($1\frac{1}{8} \times \frac{5}{8}$ of an inch).

Growth.—(*a*) *The Hatchling:* Phipson reported young measuring 190 mm. ($7\frac{1}{2}$ inches) long when emerging from the eggs, and Colonel Glen Liston had young only 178 mm. (7 inches) long at Parel when hatching. All other testimony at my command agrees in assigning to the hatchling a length of 250 to 280 mm. (10 to 11 inches). Assistant Surgeon Robertson told me the young he saw just hatched measured 280 mm. (11 inches). I measured one of those that hatched at Parel, which was bottled at once, and found it was 266 mm. ($10\frac{1}{2}$ inches) long. Nicholson remarks that at birth they are less than 305 mm. (1 foot). Now, Colonel Bannerman extracted an embryo from an egg forty-three days after deposition, and found it taped 178 mm. (7 inches). Another that was removed from an egg by me measured 228 mm. (9 inches), but it is not specified at what lapse of time after deposition. It would appear from these records that the artificial conditions in the vivarium are not conducive to the development of normal proportions.

I have had young cobras brought to me measuring 266 mm. ($10\frac{1}{2}$ inches) in June at Cannanore, and 282, 317, and 325 mm. ($11\frac{1}{8}$, $12\frac{1}{2}$, and $12\frac{3}{4}$ inches) at Fyzabad in July. Nicholson remarked that out of 1,000 cobras brought to him in May to August, 1873, 230 were young of the season, measuring from 305 to 405 mm. (12 to 16 inches), and of 1,220 in the year, 50 were from eggs deposited.

It seems to be a common belief that young cobras newly hatched are not poisonous. This is certainly a mistake, as

Mr. Phipson reported that the young cobras that hatched out some years ago in our Society's rooms killed a small Malay python (*Python reticulatus*), which was placed in their cage, a few days after they were born. They attacked it at once, biting it viciously across the back.

(*b*) *Early Life:* Phipson, referring to the hatchlings that were 187 mm. ($7\frac{1}{2}$ inches) when they emerged from the egg, says they grew an inch and a half in about two months, but, as these specimens appeared to have died of inanition having refused all food, one may be certain this underestimates the normal growth. Similarly, I have had specimens submitted to me from Parel which did not develop as cobras usually do in a state of nature. Four of these born on July 18, 1910, were consigned to spirit on November 2. I measured these, and found them 290, 305, 305, and 320 mm. ($11\frac{9}{16}$, 12, 12, and $12\frac{5}{8}$ inches). A fifth specimen born on July 20, 1910, died on December 7, and I find it is $12\frac{3}{4}$ inches long.

(*c*) *Maturity:* I have had no information of the length of gravid females.

(*d*) *Maximum Length:* The cobra, when adult, measures usually 1,370 to 1,675 mm. (from $4\frac{1}{2}$ to $5\frac{1}{2}$ feet). Larger specimens are rare, and 6-footers extremely rare. Dr. Nicholson, who for some time distributed the rewards for poisonous snakes on behalf of the Mysore Government, says that out of 1,200 specimens that passed through his hands at Bangalore, only four exceeded 1,675 mm. (5 feet 6 inches), and the largest of these measured 1,728 mm. (5 feet 8 inches). I have probably examined 500 cobras from various parts of Asia, between Baluchistan and Chitral to South China. I have only once seen a 6-footer, and this was sent to me by Mr. P. W. Mackinnon, and was killed in Dehra Dun. It taped 1,930 mm. (6 feet 4 inches). Mr. H. Hampton, writing to me from Mogok, Ruby Mines, Burma, told me he had obtained a specimen of precisely similar length, which he had sent to the British Museum. He further stated that Mr. Boulenger, in acknowledging the specimen, told him it was the largest received in that Institution, where there are upwards of seventy examples. Mr. Millard has told me of two specimens he has seen, one 1,830 mm.

(6 feet) from Khandalla, and another 1,970 mm. (6 feet 5½ inches), locality not specified. Mr. C. Bateman wrote to me in 1909 that he had killed one of the monocellate variety in the Jalpaiguri District that measured 1,970 mm. (6 feet 5½ inches) unstretched. Writing to Mr. Millard in 1906, Mr. S. M. Pearless said that the four largest examples he had killed at Badulla, Ceylon, measured respectively 1,805, 1,842, 1,980, and 2,095 mm. (5 feet 11 inches, 6 feet ½ inch, 6 feet 6 inches, and 6 feet 10½ inches), and he believed specimens running to 2,135 mm. (7 feet) were on record. The *Pioneer* of February 12, 1908, contained an account of a large cobra, quoted from the *Times of Ceylon*. It appears that on January 31, 1908, Mr. Webster, whilst motoring Sir Thomas Lipton in Colombo, saw a crowd of natives collected on the road. These proved to be watching a hole in which a snake was partly visible. Mr. Webster, by means of a noose of rope, managed to extract the snake and kill it, and it was found to be a cobra of unusual length, which, when taped, measured 2,135 mm. (7 feet). The account further stated that a local taxidermist set up the specimen. On writing to Sir Thomas Lipton, he repeated this story to me and gave me permission to see the specimen in his residence at Ossidge. It is set up in the erect posture with open mouth, showing the fangs, I measured it and found it taped 2,020 mm. (6 feet 7½ inches). The Bombay Natural History Society has recently acquired a specimen from Shamshirnagar 2,008 mm. (6 feet 7 inches) unskinned. Lyddeker* says one has been recorded 2,210 mm. (7 feet 3 inches) in length, but gives no details of the locality where it was found nor the authority who measured it.

Foes.—In the Bombay Natural History Journal† I published a list of the enemies of snakes in their natural haunts, any of which I take it may include the cobra in their dietary. Among mammals, the mongoose has been conceded a special place as a destroyer of cobras. Personally, I always had the greatest difficulty to get my captive mongooses, and

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* Royal Nat. Hist., Reptilia and Fishes, p. 223.

† Vol. XVI., p. 375.

I have had three or four, to face my captive cobras, much less attack them. Mr. Stevens in Assam told me he once witnessed an encounter between a mongoose and a cobra. The snake managed to evade the carnivore in the tall grass, and was killed by Mr. Stevens. An interesting incident was reported to me by Mr. Reid, showing that some animals have an instinctive dread ot the cobra, or, perhaps, snakes in general. A herd of buffaloes that were standing, feeding out of a row of "nands," suddenly became very excited and broke loose, stamping and snorting, and to all appearances were terrified. On investigation, a cobra was found close by, which was killed, one old cow when she saw it rushed upon its body and trampled it. This, by the way, is the method by which deer and pigs are reported to attack and destroy snakes. Gunther says the jungle fowl kills cobras, and this seems probable, as domestic fowls are known to kill and eat them ; an event of this kind happened before the eyes of the late Mr. P. W. MacKinnon in Mussoorie, his fowl killing and then swallowing the snake with no ill-effects. Both Evans and Craddock have reported instances of the cobra being victimized by the king cobra (*N. bungarus*). Mr. Gleadow once wrote to me that he saw a large monitor lizard (*Varanus*, spec.) running off with a live snake, 3 or 4 feet long, in his jaws, which, when released, was shot and proved to be a cobra.

Freaks.—In the Indian Museum there is a double-headed cobra, an example of that rare condition, anterior dichotomy.

Poison.—(*a*) *The Gland:* This organ, which is really a salivary gland, and the analogue of the parotid gland in mammals, including man, consists of a body and a neck. The body is much the shape and size of an almond kernel, and consists of (1) a thick fibrous capsule or jacket, (2) the glandular or poison secreting substance proper, and (3) a duct running centrally in the long axis of the gland. The capsule gives off numerous fibrous septa, which pass into the glandular substance and divide it into numerous chambers or pockets (the poison lakes of Bobeau). Each pocket is lined with poison secreting cells, and carries in its walls blood vessels, which convey the blood which the poison cells depend

upon for their activity. After a period of activity, the pockets, which converge forwards and inwards towards the axis of the gland, become distended with poison, and this is poured into the central duct. At the posterior pole the gland ends in a downward projecting lobe. The fibrous capsule dips into the gland, just in front of this lobe, to form a furrow for the attachment of an important muscle, the masseter. This muscle originates from the postfrontal bone and the ridges on the parietal, and is somewhat fan-shaped. Its fibres converge, and pass first backwards over the superior and internal surfaces of the gland, then downwards behind its posterior pole, and finally forwards to be attached to the furrow, or dimple in front of the lobe. The muscle, in fact, embraces a large part of the gland surface, and in contraction squeezes it much in the same way as the hand operates on a bicycle horn, the result being that poison is driven forwards into the duct to pour finally into the mouth. The neck of the gland consists of a sheath which is the direct continuation of the capsule surrounding the body, but is much thinner. Centrally is the poison duct, and intermediate between the sheath and the duct a series of mucous glands. These are placed at right angles to the axis of the duct, and discharge their mucous into that channel, where it mingles with the poison proper. In section the gland appears to the naked eye much like a sponge.

(*b*) *Physical Characters :* Cobra venom, when freshly secreted, is a clear, amber-coloured, very viscid fluid, with a specific gravity of 1,050. It resembles olive oil in appearance and consistency, and soon solidifies into an amorphous brittle mass, fissuring in all directions, and losing from 60 to 75 per cent. of its weight in the process of drying.

Lieut.-Colonel Glen Liston has very kindly weighed me a drop of fresh cobra venom in the balance at Parel Laboratory, and find it weighs approximately 35 mgms. Allowing a loss of 68 per cent. in drying, the residue of one drop would weigh 11 mgms. It is somewhat remarkable that a drop of olive oil, to which I have compared cobra venom in appearance and consistency, only weighs 6 mgms. in the same balance at Parel.

When dry the poison retains its transparency and resembles gum or amber. In the dry state it keeps well and preserves its virulent character, according to Vincent Richards, for at least fifteen years. The same authority shows that, though there has been some difference of opinion among authorities, poison is acid when fresh, and this in spite of the fact that the normal reaction of the cobra's mouth is alkaline. Lamb has confirmed these observations. After the lapse of some hours the venom becomes neutral. Dr. Nicholson says it is slightly bitter to the taste, and causes a feeling of frothy soapiness in the mouth, at the same time stimulating the flow of saliva. The same authority remarks that the dried particles have a pungent action upon the nostrils. Lamb describes the taste as very bitter and astringent.

(*c*) *Yield :* This, of course, varies with the size of the cobra, but even in specimens of similar length other factors affect the yield. Lamb says : " It is an observation of common occurrence in this laboratory (Parel) that a cobra newly caught will yield from 20 to 30 large drops of poison, while after he has been a captive for some time, this quantity will have diminished to from 6 to 10 drops and in time to *nil.*" Dr. Nicholson observed that the yield was more abundant in wet weather. Under the influence of anger, poison is secreted unduly copiously. Doubtless, age, health, and individual vitality also influence the quantity secreted.

The venom in its fluid state is found to vary a good deal in concentration, a cobra's yield is therefore calculated by the amount of solid residue left after drying. Cunningham's average for nine cobras was 254 mgms. Lamb's for fourteen cobras 231, and Roger's for two cobras 249 mgms. Lamb found that by provoking cobras, so as to make them bite viciously, the yield collected in glasses was considerably augmented, as compared with that collected by simple pressure over the glands, and amounted to an average of 373 mgms. for three cobras. Cunningham obtained from one cobra the enormous quantity of 725 mgms. The amount of solid, it will be seen, ranges between 200 and 726 mgms. in healthy adult cobras. Acton and Knowles have shown that

the yield is very variable, and for fifty cobras, varying in length from 2 feet 10 inches to 5 feet 10 inches, ranged between 30·2 and 881·4 mgms. of desiccated poison. Further, that one snake, 4 feet 4 inches in length, furnished only 30·2 mgms., whilst a young one only 2 feet 10 inches in length furnished 31 mgms. Again, one cobra 4 feet 10 inches in length yielded 143·4 mgms., whilst another of exactly similar proportions yielded 706·6 mgms. The average yield for these fifty cobras was 317 mgms.

(*d*) *Amount injected at one Bite:* Acton and Knowles estimate that the average discharge of venom at a bite is about 211 mgms. The variability of the amount injected is exemplified by many experiments on rats. Thus, no less than six rats bitten by cobras, varying in length from 2 feet 10 inches to 4 feet 8 inches, did not die as a result.

(*e*) *Toxicity:* Lamb has shown that even the dried product varies in its degree of toxicity, as he found the minimal lethal dose for rats was ·07 mgms. with one sample, and ·04 with another. Again, in Acton and Knowles' experiments, they injected 2 mgms. of poison into fifty rats. As a result all succumbed, but where one died in 53 minutes, another did not die for 20 hours!

(*f*) *Rapidity of Absorption:* Blake found that a poison injected into the jugular vein reached the pulmonary circulation of a dog in from 4 to 6 seconds, and the cardiac circulation in 7 seconds. A poison injected into the same vein was distributed throughout the circulation in 9 seconds. It is this extreme rapidity of transmission in the blood stream that accounts for the fatal issue in experiments where a poisoned member is amputated or wound excised almost immediately after being bitten. Russell caused a cobra, after biting a dog twice, to inflict a wound in the leg of a pigeon, and amputated the member one minute later, but the bird died in two hours. On dissecting up the limb the extravasation, peculiar to the local action of snake poison, was observed half an inch above the punctures, and almost reached the point of amputation.

Fayrer* (Expt. 3 of Series 16) caused a cobra to bite a dog in a fold of skin in the groin. The wound was entirely excised "at once," but death took place in 6 minutes! In another experiment (No. 13 of Series 15), the same authority repeated the same performance, the part being "immediately" excised (within 2 seconds). The animal died 2 hours and 35 minutes later. It appears probable that the initial absorption of the poison is far more speedy in the first few seconds (or minutes) than subsequently (?). Acton and Knowles have repeated these experiments, and find that if amputation is not accomplished within ten minutes of a lethal injection, the amount already absorbed will cause a fatal issue.

(*g*) *Lethal Dose for Man:* It is a well-established fact that cobra venom may be swallowed in large quantities without producing any baneful results. Elliot gave a dog 10 drops—a dose sufficient to kill 10 dogs, if injected into the tissues—without producing any ill-effect. On another occasion he gave 20 drops to a goat with the same result. Fraser, by graduated doses internally, succeeded in giving a cat 1,000 times the lethal dose by injection beneath the skin. Calmette repeated the experiment, giving 1,000 times the lethal subcutaneous dose to a cat internally, without producing symptoms of poisoning. It is the access of the venom into the blood stream that constitutes its extreme danger to all animals. The lethal dose of the poison so introduced has been accurately ascertained for many animals by experiment, but in man must remain to some extent conjectural. Various estimates have been made, based on experiments on the lower animalss. Fraser's estimate is 31 mgms., whilst Calmette made it about 10 mgms. Lamb, however, finding that ·25 mgms. is approximately the minimal lethal dose per kilogram weight in monkeys and postulating an equal degree of susceptibility in man, concludes that the dose for a man weighing 10 stone would be about 15 to 17·5 mgms. (or ·0015 to ·0017 grammes). If we

* Thanatophidia of India (1874).

take Lamb's estimate of the lethal dose for man, which is probably nearest the mark, and strike an average for the 25 cobras experimented with by Cunningham, Lamb, and Rogers, the average yield of which amounts to 240 mgms; we may state that an average cobra contains poison enough in its glands to kill fifteen men. An exceptional cobra may even contain sufficient poison to kill forty-five men! Acton and Knowles, by well-reasoned induction and a highly ingenious system of experiment, arrive at the same conclusion as Lamb, and place the lethal dose at 15 mgms. (or ·0015 grammes) of dried poison.

(*h*) *Uncertainty of Effects:* When one considers all these facts, viz., the extremely small quantity that constitutes a lethal dose in man, the number of lethal doses of venom available in a normal cobra, and the rapidity of absorption into the blood, it is extremely remarkable that *any* bitten subject can escape receiving his death warrant however trivial the injuries sustained. In spite of this, it is a well-established fact that a certain number of bitten subjects in which poison too has been indubitably injected do recover, and without treatment. Of course, it is obvious in these cases that the dose absorbed was a sublethal one.

It seems to me very remarkable how variable are the results of a cobra bite as testified by experiment in the lower animals. Elliot* reports, on the authority of Surgeon-Major Browning, I.M.S., that on one occasion "a healthy cobra bit a dog in two places with no results; another bite from the same cobra on the same animal resulted in death." Fayrer† records a parallel case. "A mongoose and a full-sized cobra were put into a large wire cage at 1 P.M. The snake struck at the mongoose, and they grappled with each other frequently, and apparently the mongoose must have been bitten, as the snake held on to it about the neck and head. The next day at noon

* Trans. Brit. Med., Assoc. S. Ind. Br., 1895, p. 7.

† Thanatophidia, p. 69.

both were well." There had been two cobras with this mongoose during the night "both equally fierce, striking each other and the mongoose, but the latter was not poisoned. He was scratched by the cobra rather severely on the head. But on being bitten in the thigh by the same cobra, when both were taken out of the cage, "the mongoose succumbed to the poison very rapidly." Again, Dr. Davy reports a case where "a cobra, 5 feet long, bit a hen, fixing its fangs in the skin covering the lower point of the left pectoral muscle, and keeping its hold about two or three seconds." The hen died after eight hours. Compare with this Fayrer's fowl that was bitten "by a large cobra in the thigh fell into convulsions immediately and died in 50 seconds." The literature on the cobra is full of similar conflicting results following its bite; it is obvious that if such occur in lower animals during experiment, they will occur also in the human subjects bitten by accident. Speaking of this uncertainty, Fayrer says "snakes frequently strike, and even wound without poisoning."

There is abundant evidence to show that snakes like the cobra, which are known to be capable of delivering a mortal wound, frequently fail to do so, though they may inject poison in considerable quantity. Vincent Richard says: "a man or an animal may be very seriously poisoned by a rattlesnake, or indeed by any snake, and yet recover under subjection to various or even no treatment." Weir Mitchell cites an experiment with a dog, which he says "has especial value as showing how exceedingly grave may be the signs of poisoning, and yet how rapid and complete may be the rally and escape. At one stage the dog was lying on the floor, scarcely breathing, and nearly pulseless." I could multiply instances "*ad libitum.*" So far as the human subject is concerned there are many cases of cobra bite recorded where no ill-effects were produced, or symptoms of varying severity not ending in death, though no treatment was attempted. Dr. Davy, after remarking that the effects of cobra bite "vary a good deal according to circumstances not easy to calculate," says: "I have seen several men who have recovered from the bite

of the hooded snake, and I have heard of two or three only to whom it has proved fatal." Russell mentions a cooly woman whom he saw 10 hours after being bitten by a cobra. Paralysis had advanced so far as to seriously affect her throat, and he had difficulty in getting her to swallow a Tanjore pill. She recovered completely. He mentions another case of a drunken Irishman who declared he was proof against any snake owing to his nationality, and put a cobra into his shirt before an assembled throng. The snake bit him severely in the breast, he suffered not only great pain locally, but serious constitutional effects, nevertheless he recovered. Dr. Nicholson records a case where two snakemen, under the influence of drink, got bitten by one of their cobras. As some time had elapsed when he saw them, he coloured some water pink with his dentifrice, which he gave them to allay their fears. Both recovered, though one had a swollen hand next day as a result of the accident. Calmette records another very interesting case where a man was profoundly under the influence of cobra poisoning following a bite, but who persistently refused antivenene which was to hand, took his chance, and recovered completely.

These cases are most instructive, and serve to point two lessons. One is that however serious the symptoms arising from a cobra bite, there is always hope. The other lesson is that nobody is qualified to assume that any given treatment, adopted in a certain case, has been responsible for its favourable issue. There can be no doubt that the failure to realize this latter truth has been responsible for the host of reputed antidotes, which have been vaunted from time to time since the days of Celsus, all of which have proved futile when subjected to scientific experiment. It is difficult to say what percentage of cases of cobra bite would not prove mortal. Dr. Davy, speaking of Ceylon cobras, says that recovery follows the bite as often as death. In the article on Snake Poisons in Allbutt's system of medicine, Lamb and Martin say: "the mortality in persons bitten by the larger snakes of India and South America would not, from the scanty records available, appear to be more than 30 per cent."

(*j*) *Toxins :* Chemical formula $C_{34}\ H_{20}\ O_{52}$ (Faust) :—

(1) Toxins operating on nerve cells—

(*a*) A depressor that paralyses the respiratory centre (Brunton and Fayrer).

(*b*) A depressor to the vasomotor centre (Lamb).

(*c*) A depressor that paralyses centres in the bulb (A. J. Wall).

(*d*) A depressor that paralyses the ends of nerves including the phrenic nerves (Brunton and Fayrer).

(*e*) A destructive agent to cells generally in the spine and cord (Lamb and Hunter).

(2) A direct stimulant to cardiac muscle (Brunton and Fayrer, through Elliot)—

(*a*) Action on muscle or nerve endings.

(*b*) Vago-inhibitory apparatus.

(*c*) Vaso constriction of arterioles.

(3) A vaso constrictor (Brunton and Fayrer).

(4) Toxins affecting the constitution of the blood—

(*a*) An antifibrin ferment that reduces clotting of blood (Brunton and Fayrer).

(*b*) "Hæmolysin" destructive to red blood cells (Hilson, Ragotzi).

(*c*) "Leucolysin" destructive to white blood cells (Flexner and Noguchi).

(*d*) An antibactericidal principle that destroys the normal activity that blood exhibits towards the invasion of germs into the body (Flexner and Noguchi).

(5) Toxins destructive to other cell elements—

(*a*) "Hæmorrhagin" destructive to the lining membrane of arterioles (Flexner).

(*b*) Agents destructive to cells at the seat of injury.

(*k*) *Analysis of the Action of the Toxins*—

(1) (*a*) The "neurotoxin" paralysing the respiratory centre is the predominant agent in causing death. It is assisted by (1) (*d*), and slightly by (4) (*b*).

(*b*) The effects of the "toxin" that depresses the vaso-motor centre are neutralized by the combined antagonistic action of (2) and (3). The result is that after breathing has ceased, artificial respiration is capable of prolonging life for many hours.

(*c*) This "toxin," operating on several centres in the bulb, evokes symptoms exactly similar to those seen in bulbar palsy, where lips, tongue, throat, and voice are paralysed.

(*d*) Assists (1) (*a*) in the production of asphyxia.

(*e*) The toxin "amyotrophin" destroys nerve cells generally, but its action is not seen in the human being, death being brought about by the more speedy action of (1) (*a*). When (1) (*a*) is insufficient to cause death, the dose of "amyotrophin" is too small to produce death, or even to seriously affect the bitten subject.

(2) The cardiotonic element, by reinforcing the heart muscle, helps to preserve the blood pressure, and helps to counteract the effect of (1) (*b*)

(3) The vaso-constrictor, by reducing the calibre of the blood vessels, raises blood pressure, and acts indirectly in reinforcing the heart. With (2) it completely counteracts the effect of (1) (*b*).

(4) (*a*) The effect of the antifibrin ferment is seen in the reduction of clotting power in the blood, and this in conjunction with (5) (*a*) accounts for the hæmorrhages that may occur.

(*b*) "Hæmolysin," by destroying red blood cells, contributes to the asphyxia produced by (1) (*a*) aided by (1) (*b*).

(*c*) "Leucolysin" by destroying white blood cells, reduces the normal power of the system to resist microbic invasion of all sorts.

(*d*) This aids the action of (4) (*c*), if indeed it is a separate entity.

(5) (*a*) "Hæmorrhagin," by damaging the lining membrane of the arterioles, allows leakage of the vessel contents. It in conjunction with (4) (*a*) favours the occurrence of hæmorrhages.

(*b*) The local destruction of cells accounts for sloughing of the wounds, and leaves an ulcer when the dead tissues have separated.

(*l*) *Symptoms in Man—Local:* The first, and perhaps invariable symptom, is *pain*, which is of a stinging or burning character out of all proportion to the mechanical injuries sustained. It comes on immediately and persists, perhaps lasting for hours. If pain is experienced only to the degree excited by ordinary pricks or scratches and is but transient, there is a justifiable presumption that poison has not been introduced. Coincident with the pain, and almost as speedy in its appearance, is *swelling*, which gradually increases until perhaps the whole limb is puffy. The third sign that venom has gained access to the wounds is the *oozing of a blood-stained serum*. If, on the other hand, the punctures are sealed with clot, as in ordinary wounds shortly after injury, there is every probability, if not actual certainty, that poison has failed to find entry into the tissues. The fourth cardinal sign is one which cannot be detected until the tissues in the site of the wound have been cut into, though it may be inferred if rapidly ensuing swelling has occurred, accompanied with the other signs *the tissues assume a very characteristic appearance;* the parts become purplish centrally, the colour fading to scarlet and then pinkish, and a thin serum exudes. In one case, Wall (A. J.) found this purplish effusion, which is characteristic of the action of snake venom, within 30 seconds of the injection of the poison. When present, it is absolute

proof of the absorption of venom; if absent, it is probably equally good proof of the failure of the poison to have reached the tissues.

How intensely irritant the venom is locally is apparent from the rapidity of the symptoms noted above, added to which is the fact that in many cases, where the bitten subject recovers, the tissues involved actually mortify, and are thrown off as a slough. Occasionally, one sees natives with withered limbs stated to be due to the effects of a snake bite.

General: The constitutional effects are a gradual but rapidly advancing paralysis, due to the action of the poison on the brain and cord. Sooner or later the bitten subject complains of weakness in the legs, and is prompted to recline rather than walk or sit. This weakness creeps up the trunk, and affects the muscles of the neck, so that the head droops; the muscles of the tongue, lips, and throat, so that speech becomes difficult, the lower lip falls away from the teeth, and allows the saliva to dribble, and swallowing becomes difficult or impossible. The eyelids too droop, giving a sleepy expression to the face. While these paralyses are waxing, the respiratory function becomes affected, breathing difficult, then laborious, and finally death from respiratory failure ends the scene. Among other toxic symptoms may be mentioned nausea or actual vomiting, and, not infrequently, hæmorrhages from various orifices, as a result of the action of the poison on the blood, altering its composition, reducing its coagulability, and dissolving the red blood cells.

An easy aid to remember the essential action of the poison is supplied in the word "COBRA," CO stands for COrd and BRA for BRAin, implying that it is the central nervous system that is in the main affected. Again "C O B R" stand for Coagulation Of Blood Reduced, and the final A gives the mode of death, viz., by Asphyxia.

(*m*) *Illustrative Case:* Cases of cobra toxæmia are very seldom well reported, even by the medical profession, a great deal being often left to the imagination. I will give one example that was excellently recorded by Dr. Hilson as

follows : " On a night in June, at about half-past 12 o'clock, Dabu, a Hindu punkah cooly, was bitten on the shoulder by a cobra, whilst sleeping. On inspecting the wound, there were found over the prominence of the right deltoid muscle, and about three-quarters of an inch apart, two large drops of a clear serous-like fluid tinged with blood, which had apparently oozed from two small punctures, so minute that they could not be perceived by the naked eye. A burning pain was complained of in the neighbourhood of the bite, which rapidly increased in intensity, and extended so as to affect a circular portion of the integument of the size of an ordinary saucer ; and judging from the description given of it, it was very similar in character to that produced by the sting of a scorpion.

" At 12.45 A.M., or about a quarter of an hour after being bitten, he complained of a pain in his shoulder shooting toward his throat and chest, and said he was beginning to feel intoxicated ; but there was nothing in his appearance at this time to indicate that he was in any way under the influence of the poison. On the contrary, he was quite calm and collected, and answered all questions indifferently, at the same time that he was fully alive to the danger of his condition. The pupils were not dilated, and they contracted when exposed to the light of a candle ; his pulse was normal and there was no embarrassment of the respiration. About five minutes after, he began to lose control over the muscles of his legs, and staggered when left unsupported. At about 1 o'clock, the paralysis of the legs having increased, the lower jaw began to fall, and frothy and viscid saliva to ooze from the mouth. He also spoke indistinctly like a man under the influence of liquor. At 1.10 A.M. he began to moan, and shake his head frequently from side to side. The pulse was now somewhat accelerated, but was beating regularly. The respirations were also increased in frequency. He was unable to answer questions, but appeared to be quite conscious. His arm did not seem to be paralysed. He continued to moan and shake his head from side to side, as if trying to get rid of viscid mucus in his throat. The respirations were laboured,

but not stertorous. The breathing gradually became slower, and finally ceased at 1.44 A.M., while the heart continued to beat for one minute longer."

(*n*) *Interval before Death.*—The interval that elapses between a cobra bite and the death thereby occasioned varies considerably. The shortest interval that I have any record of is half an hour. Fayrer reports one case that died in this short interval, the bitten subject being an adult man. *The Pioneer* of April 27, 1908, reported a European lady, Mrs. Cockely, succumbing to the bite of a cobra in half an hour. The wound was inflicted on the top of her toe, and the snake was killed there and then by her husband. More often the interval that elapses amounts to hours, from about two to six hours being perhaps usual. A woman, mentioned by Fayrer, died after eight hours, and other cases have been reported exceeding twenty-four hours.

(*o*) *Treatment recommended—Antivenene:* This serum is the only known remedy for snake bite. The Kasauli product is curative for this toxæmia and that of Russell's viper. For a successful issue, it is necessary (1) to inject the serum as soon as possible, (2) to inject it intravenously, and (3) to inject 40 cc., and then be guided by results. If the symptoms are not observed to wane within half an hour, the dose should be repeated, or if the case is desperate, a second injection given without waiting so long.

The antivenene now issued is reckoned to retain its virtue for two years at least, after which it should be rejected. If the serum is old, a larger dose than 40 cc. should be injected. Injections into the tissues are far less speedy in their action, and a double dose would probably be necessary.

Although cobra venom does not directly depress the heart, other influences are very likely to affect that organ in cases of cobra poisoning. Pain, fright, and cold are all powerful depressants to cardiac activity, and may seriously endanger life. It is most essential, therefore, in treating cobra poisoning to look for any tendency to faintness, and treat this vigorously, as recommended under *Bungarus cæruleus* (page 448). Antivenene of unquestionable activity, administered intravenously

in adequate doses, cannot be expected to save a patient who is suffering from cardiac weakness due to non-toxic causes. A feeble or rapid pulse, with cold body surface, specially noticeable in the extremities, and a subnormal temperature are, though silent, vociferous appeals from an inarticulate subject for vigorous stimulation of the heart.

Parasites.—(*a*) *Ectozoa:* A very common parasite to infest the cobra is the tick *Aponomma læve* variety *paradoxum*, which attaches itself between the scales. The adult is about the diameter of a lentil, flat, and of a dark plumbeous colour. I have also seen minute scarlet mites, apparently the same as those found on *Oligodon sublineatus*, which Professor Nuttall identified as larval forms, probably of a *Gekobia*.

(*b*) *Entozoa:* Both nematode and cestode worms inhabit the stomach and intestine, the identity of which I have not been able to determine.

(*c*) *Hæmatozoa:* Laveran mentions having found hæmogregarines, viz., *Hæmogregarina najæ*, in the red blood cells.

Lepidosis.—(*a*) *Typical—Rostral:* The rostro-nasal sutures are about half the rostro-internasals, and subequal to the rostro-labials. *Internasals:* The suture between them is about half to three-fifths that between the præfrontals, and half or less than half the internaso-præfrontals. *Præfrontals:* The suture between them longer than the præfronto-frontals; touching the internasal, præocular, and supraocular. *Frontal:* The fronto-supraocular sutures are about twice the fronto-parietals. *Supraoculars:* Longer than the frontal, about three-fourths the breadth of the frontal along a line connecting the centres of the eyes. *Nasals:* Subequal in depth. *Præocular.* Longer than deep; hardly reaching the top of the head; touching the internasal. *Postoculars:* Three; subequal. *Temporals:* Lower as long as the supraocular. *Supralabials:* Seven; the 1st, 2nd, and 3rd touching the nasals; 3rd and 4th the eye; and the 5th and 6th the temporals. *Sublinguals:* The posterior subequal to the anterior; completely separated by a single scale nearly as large; touching the 4th and 5th infralabials. *Infralabials:* Five; the 4th and 5th subequal, 5th nearly as long as the

posterior sublinguals, and about twice as broad as those shields, touching two scales behind. *Cuneate :* A small scale wedged in between the 4th and 5th infralabials. (Fig. 87.)

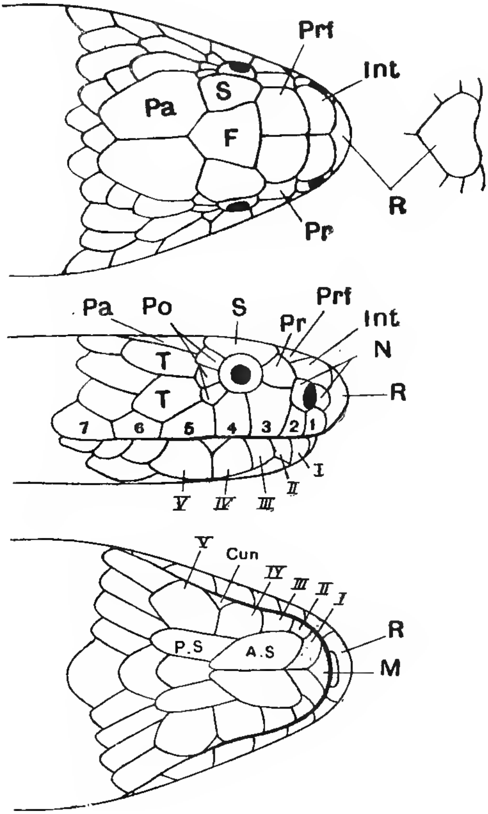

FIG. 87.—Naia tripudians.
(Life size.)

Costals : Vertebrals and last three rows rectiform ; the intermediate rows oblique. Vertebrals, breadth half or

less than half their length, about half the breadth of the ultimate row. Oblique lateral rows, breadth less than half their length. Ultimate row, breadth nearly equalling their length. In 21 to 25 rows two heads-lengths behind the head; 19 to 25 rows at midbody (23 to 25 in Ceylon specimens); and 15 to 13 two heads-lengths before the vent. The reduction at all the steps is due to the absorption of the 4th, 5th, or 6th row from the ventrals. *Ventrals:* 163 to 213 (170 to 200 in Ceylon specimens). *Anal:* Entire. *Subcaudals:* 52 to 75 (52 to 65 for Ceylon specimens). (Fig. 88.)

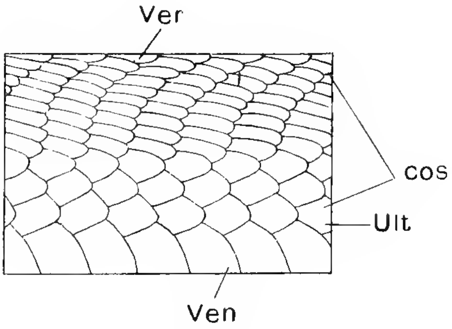

FIG. 88.—Naia tripudians.

(*b*) *Anomalies—Postoculars:* Rarely two. *Supralabial:* The third is rarely divided into an upper and a lower part. *Cuneate:* Rarely absent.

Dentition.—*Maxilla:* Prænodal: in Chamber's Encyclopædia the article on the cobra says that its fangs are not canaliculate, but grooved. Mr. Boulenger too, in his Catalogue. refers to the fangs as being grooved, and they are shown with a deficiency in the anterior wall in the figures in Fayrer's and other works. This is most certainly not correct. The fact that there is an indistinct line on the anterior face of the fang

does not affect the question of its being canaliculate. The line referred to is a seam which marks the spot where the circumflexed walls of the canal meet and blend. There is a considerable opening at the base of this seam and a much smaller one near its point, where the poison finds exit. It is not generally known that it was this beautifully specialized instrument in the jaws of a poisonous snake that led a medical man to design the surgical instrument, used so freely in these days, in the form of the hypodermic needle.

The cobra's fang is relatively small compared with viperine fangs, and is a much more solid and stronger weapon. The length of my largest cobra fang is 7 mm., and was taken from a large adult. The length of the fangs in a 15-inch *Echis* in my collection is 5 mm., and those in a 3 feet 4 inch viper (*Trimeresurus anamallensis*) are 13 mm. My largest hamadryad (*N. bungarus*), measuring 11 feet 5 inches, had fangs 10 mm. in length.

There are usually two fully-operative fangs fixed in each maxilla, but these are shed singly at intervals, and from Fayrer's experiments eighteen days was the shortest period that elapsed between drawing them and the fixation of a new one. (Fig. 89.)

FIG. 89.—Maxilla of Naia tripudians.
Compare with Fig. 92.

Postnodal: A solitary tooth. *Palatine:* 6 to 8. *Pterygoid:* 11 to 15. *Mandibular:* 13 to 15.

Distribution.—(*a*) *General:* It is represented by one or other of its many varieties in Ceylon and the Andamans; throughout Peninsular India to the Himalayas. In the

north-west it extends through Baluchistan to Transcaspia; and in the north-east to Bengal and Assam. Further east it extends through Burma and Indo-China to Southern China and the Chusan Islands and Formosa. The Malay Peninsula, and Malay Archipelago from Sumatra to the Philippines.

(*b*) *Local:* It is a snake of the plains, but may be met with in hills even up to an altitude of 6,000 feet.

It is a common snake everywhere.

Genus CALLOPHIS.

(Greek "kallos" beautiful, "ophis" snake, in allusion to their beautiful colouration.)

General Characters—All the species are small, only growing to 2½ feet or less. Head moderately depressed, moderately or very short. Snout moderately or very short, gently declivous, without canthus, and broadly rounded terminally. Eye small, with round pupil. Nostril moderately large, almost wholly contained in the anterior nasal; occupying about the upper two-thirds of the suture. Neck not or but little apparent. Body moderately or very elongate, stout or slender, cylindrical, of even calibre throughout. Belly rounded. Tail short or very short, measuring from one-twelfth to one-sixteenth the total length.

Identification.—The costals in 13 rows in the whole body length taken with the 3rd supralabial touching the postnasal and the eye will indicate the genus.

Habits.—Terrestrial. Diurnal. Very gentle by nature. Sluggish.

Food.—Subsist mainly on other snakes.

Poison.—Nothing known of the effect on man.

Lepidosis.—*Rostral:* Touches six shields. *Internasals:* A pair. *Præfrontals:* A pair. *Frontal:* Touches six shields. *Nasals:* Divided. *Loreal:* Absent. *Præocular:* Absent or

present. *Postoculars:* One or two. *Temporal:* One, large. *Supralabials:* Six or seven. *Sublinguals:* Two subequal pairs. *Infralabials:* Four.

Costals: Longer than broad, rectiform, smooth, without apical pits or facets. Vertebrals not enlarged. Last two rows increasing in breadth. Last row broadest. *Ventrals:* Rounded. *Anal:* Divided. *Supracaudals:* In even rows. *Subcaudals:* Divided.

Dentition.—*Maxillary:* Postnodal, 1 to 3; isodont (absent in *macclellandi*). *Palatine:* Anododont, feebly kumatodont. *Pterygoid:* Anododont, scaphiodont. *Mandibular:* Ano donont, scaphiodont.

Distribution.—South-Eastern Asia.

Five species have been described, of which one occurs in Ceylon, viz., *trimaculatus*.

Callophis trimaculatus (Daudin).

(Greek "treis" three, and "maculatus" spotted.)

The Slender Coral Snake.

Synonymy.—*Coluber melanurus, Vipera trimaculata, Elaps trimaculatus, E. melanurus.*

History.—First referred to by Russell in 1796, who also gave a very fair figure in his first volume (Plate VIII.). Christened by Daudin in 1803.

General Characters.—A small snake, scarcely exceeding 1 foot in length. Head moderately depressed, moderately long. Snout moderately long, slightly declivous, without canthus, broadly rounded terminally. Eye rather small. Nostril moderately large; in the upper two-thirds of the suture between the nasals. Neck barely evident. Body very elongate, slender, of even calibre throughout. Belly rounded. Tail very short, being about one-sixteenth the total length.

Identification.—Costals in 13 rows in the whole body length, six supralabials, the first three touching the nasals, constitute a syndrome peculiar to this species.

Colouration.—Dorsally the colour is a uniform light chestnut as applied to a horse. Haly says golden gray. Each scale has a brown or blackish spot. The head and nape are black, and there are two well-defined whitish spots behind the parietal shields. The tail has a black band at the base, and another subterminally. These with the black head account for Daudin's name *trimaculatus*. The ventrum in Haly's specimen is described as rich mauve below the head, graduating to pale yellow, then orange, and finally crimson before the vent. Willey's specimen agrees, except that it lacks the mauve zone anteriorly. Beneath the tail the subcaudals are pearly gray (Haly), pale bluish (Willey), between the two black bands. These beautiful colours fade almost at once in spirit.

The snake bears a strong superficial resemblance to *Oligodon sublineatus*. Willey suggests that the two occipital spots may come into the category of "false eyes," and, as such, may terrify its enemies and aid in its protection.

Habits.—Very little is known. Haly remarks that the specimen he captured "was making for the water with its tail curved over in such a way as to carry the crimson and black anal spot uppermost." I have received confirmation of this curious action from Mr. C. E. C. Fischer, I.F.S. He encountered a specimen at Walayar, on the boundary between the Malabar and Coimbatore Districts of South India, and in forwarding me the snake, he wrote "when disturbed it curled its tail upwards so as to expose the coral red anal shield and a few of the posterior ventral scales. The effeet was very striking, and I presume was a demonstration meant to terrify or warn me." A similar action was noted by Flower of another snake, viz., *Cylindrophis rufus*, a species not nearly related to the slender coral snake, but with a similar adornment of crimson beneath the tail. He remarked of this species "when touched or worried it will not attempt to strike or bite, but keeps its head flat on the ground, usually hidden under the

folds of its body; its *tail*, however, it raises off the ground and holds aloft curved over backwards in the most extraordinary manner, so that any casual observer would imagine the tail was the head, and think the snake to be threatening to strike."

D'Abreu says it appears to be a very timid snake. A captive specimen could not be induced to bite anything. When seized with the forceps it lashed out violently and finally wriggled itself into a knotty bunch. One in captivity always concealed itself in the loose earth in its cage.

Mr. Drummond-Hay tells me the specimen he encountered did not try to escape, but appeared most sluggish. Not knowing what it was, its manner so disarmed suspicion that he picked it up, and carried it about two miles in his hand. during this time it was quite quiet, and made no attempt to bite him.

Food.—Nothing known. As most of its near allies subsist on other snakes, this species is likely to exhibit similar tastes.

Growth.—My largest specimen was 395 mm. ($15\frac{1}{4}$ inches).

Poison.—Nothing is known as to its effects on any mammals, and the snake is too scarce for the poison to have been investigated as yet in the laboratory.

Lepidosis.—(*a*) *Typical—Rostral :* The rostro-nasal sutures longer than the rostro-internasals, more than twice the rostro-labials. *Internasals :* The suture between them about three-fifths that between the præfrontals, and half or less than half the internaso-præfrontals. *Præfrontals :* The suture between them longer than the præfronto-frontals; touching the internasal, postnasal, præocular, and supraocular. *Frontal :* The fronto-supraocular sutures rather shorter than the frontal parietals. *Supraoculars :* About two-thirds the length of the frontal, and about two-thirds the breadth of the frontal along a line connecting the centres of the eyes. *Nasals :* Subequal in depth, or the anterior rather deeper. *Præocular :* Barely reaching the top of the head. *Postoculars :* Two; subequal. *Temporal :* As long as or rather longer than the supraocular. *Supralabials :* Six; the 1st, 2nd, and 3rd touching the nasals; 3rd and 4th the eye; and the 5th and 6th the temporal; 6th longest. *Sublinguals :* The posterior as

long as the anterior, touching the 4th infralabial. *Infralabial:* Four; 4th largest, about as long as the posterior-sublinguals, but twice as broad as those shields, and touching two scales behind. (Fig. 90.)

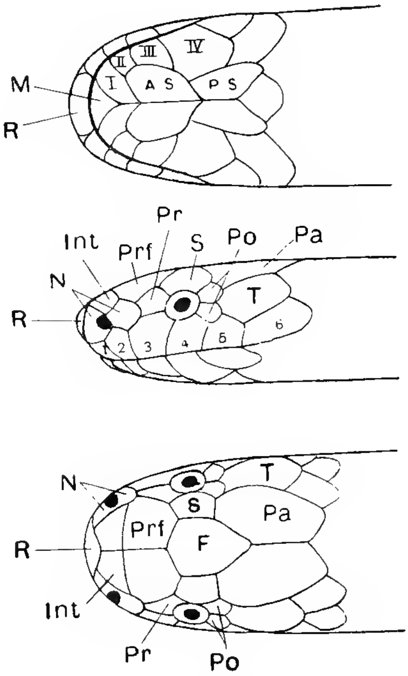

FIG. 90.—Callophis trimaculatus.
(× 3.)

Costals: Vertebrals, breadth of scales about three-fourths their length, and about three-fourths those of the ultimate row. Last two rows gradually increasing in breadth. Ultimate row broadest, its scales about as broad as long. In 13 rows in the whole body length. *Ventrals:* 228 to 274 rounded. *Anal:* Divided. *Subcaudals:* 24 to 36.

Dentition.—From one skull in my collection. *Maxillary:* Postnodal, 2 or 3. *Palatine:* 6 to 7. *Pterygoid:* 4 (?) to 6. *Mandibular:* 8 to 9.

Distribution.—(*a*) *General:* Peninsular India, as far north as Bengal (Nerva, Russell), and Ceylon.

(*b*) *Local:* Jerdon says "common in Burma." It is certainly not common in that Province, nor do I believe that it occurs there at all. Its allies, *maculiceps* and *macclellandi*, are found there. In Ceylon Haly recorded one from Tissamaharama (north-east of Hambantota) and another from Trincomalee. Willey found his specimen near Trincomalee, and I received one specimen from Mr. Green from Matale. Abercromby records two from Matale. One in the Colombo Museum is from Balangoda (Mr. Drummond-Hay's specimen). It is a decidedly rare snake in India, and seemingly so in Ceylon.

It is an inhabitant of the plains, but ascends into hills. It has been recorded by Beddome from the Anamallays, and I have had a specimen from Mahableshwar (4,500 feet).

Family **AMBLYCEPHALIDÆ.**

Represented in South America and South-East Asia, but not in Ceylon.

Family **VIPERIDÆ.**

(Named from the type genus *Vipera.*)

General Characters.—Head moderate to large, and in some bears a scale-covered, horn-like, epithelial appendage on the eyebrow. Snout very short to moderate; with or without a canthus; some with a boss or a scale-clad, horn-like, epithelial appendage anteriorly. Some have a large opening between the eye and the nostril, viz., the loreal pit. Eye moderate, with vertical pupil. Nostril lateral; small, moderate, or large. Neck moderately or very markedly constricted. Body moderately robust to massive, cylindrical, attenuating more or less from the middle in both directions. Belly rounded or keeled laterally. Tail short.

Habits.—Terrestrial, arboreal, or aquatic. Sluggish. Fierce when roused.

Food.—Mammals, birds, reptiles, batrachians, fish, centipedes.

Breeding.—All whose habits are known are viviparous, except *Causus rhombeatus*, *Trimeresurus mutus*, *T. monticola*, and *Ancistrodon rhodostoma*.

Poison.—All are poisonous. Many are fatal to man, but many others rarely, if ever, cause a fatal toxæmia.

Lepidosis.—The head in some is covered with large shields more or less after the Colubrine type. In others there are only small scales.

Costals: Longer than broad; all rectiform, or some oblique; smooth or keeled; with or without apical facets. Vertebrals not enlarged or feebly enlarged. *Ventrals:* Broad, three times the breadth of the last costal row; rounded or laterally keeled. *Anal:* Entire. *Subcaudals*: Entire or divided.

Dentition (for Indian species).—*Maxilla:* With a pair of canaliculate fangs, and no other teeth. *Palatine:* Number 1 to 6; with or without edentulous spaces anteriorly and posteriorly (completely edentulous in *Trimeresurus jerdoni*). *Pterygoid:* Number 5 to 19; scaphiodont. *Mandibular:* Number 10 to 19; scaphiodont.

Distribution.—Europe, Asia, Africa, and America.

There are thirteen genera arranged in two sub-families. Five are represented in Indian limits, and of these four occur in Ceylon.

KEY TO THE SPECIES OF VIPERIDÆ.

(*For Ceylon Species.*)

(A) Costals in 17 rows at midbody. A loreal pit. (See Figs. 96 and 97) .. *Ancistrodon.*
(*a*) Slight boss on top of snout .. *A. millardi.*
(*b*) A horn-like erect appendage on snout .. .. *A. hypnale.*
(B) Costals in 19 rows at midbody. A loreal pit. (See Fig. 98) .. *Trimeresurus trigonocephalus.*
(C) Costals in 29 to 31 rows at midbody. No loreal pit. (See Figs. 91 and 93.)
(*a*) Subcaudals divided .. *Vipera russelli.*
(*b*) Subcaudals entire .. *Echis carinatus.*

Sub-family 1 **Viperinæ.**

(Named from the type Genus *Vipera.*)

Identification.—Without an opening (loreal pit) between the eye and nostril.

Distribution.—Europe, Asia, Africa.

Arranged in nine genera, of which three are represented in Indian limits, and two in Ceylon.

Genus VIPERA.

(Latin, said to be from " vivus " alive, and " pario " I bring forth. The common European viper (*V. berus*) was known from remote times to produce its young viviparously.)

General Characters (for Indian Species).—The species vary in length from $1\frac{1}{2}$ to $5\frac{1}{2}$ feet. Head flat, and subtriangular in shape. Snout rather short, with a more or less distinct canthus, obtusely rounded in front. In some it is surmounted by a horn-like, scale-covered, appendage. Eye moderate or small ; iris more or less adorned with gold speckling ; pupil vertical. Nostril moderate to large ; open ; lateral. Neck much constricted. Body robust, or even corpulent, attenuating towards the neck anteriorly and towards the vent. Belly rounded. Tail short, accounting for about one-seventh to one-fourteenth the total length.

Identification.—The top of the head covered throughout with small scales, no loreal pit, and divided subcaudals will suffice to identify the genus among Ceylon snakes.

Habits.—Sluggish in disposition, but fierce when roused, nocturnal, and some fatal to man.

Food.—Feeds mainly on small mammals, but also eats birds, lizards, and batrachians.

Breeding.—Viviparous.

Poison.—Poisonous ; some fatal to man.

Lepidosis.—*Rostral :* Well developed ; in some species touching the nasals, in others not. *Supraoculars :* Large ; undivided or broken up. *Nasals :* Entire ; variable in shape.

Supralabials : Six to thirteen ; the anterior one or two touching the nasals, none touching the eye, being separated from it by from one to three rows of scales. *Sublinguals :* One pair ; in contact with three or four infralabials. *Infralabials :* Three or four.

Costals . Longer than broad, rectiform ; keeled ; with or without apical pits. Vertebrals not enlarged. Ultimate row enlarged, its scales twice or more than twice the breadth of the vertebrals. In 19 to 33 rows in midbody, often two less two heads-lengths behind the head, and from four to eight less two heads-lengths before the vent. *Supracaudals :* In even rows. *Ventrals :* 120 to 180 ; rounded. *Anal :* Entire. *Subcaudals :* 20 to 65 ; divided.

Dentition (in Asiatic species).—*Maxillary :* Two canaliculate fangs placed side by side. *Palatine :* Anododont, isodont; with an edentulous space anteriorly, or posteriorly, or both. *Pterygoid :* Anododont, isodont ; posterior half edentulous. *Mandibular :* Anododont, scaphiodont.

Distribution.—There are ten species inhabiting Europe, Asia, North and Tropical Africa. Only one of these occurs in Ceylon, viz., *V. russelli.*

VIPERA RUSSELLI (Shaw).

(Named in honour of Patrick Russell.*)

Russell's Viper or the Daboia.

Sinhalese : "tic polonga" (spotted snake). *Tamil* "kanardi viriyan" (spectacle snake).

Synonymy.—*Coluber russellii, C. trinoculus, C. triseriatus, Vipera elegans, Daboia elegans, D. russellii, D. pulchella, Echidna elegans, E. russellii.*

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* This title commemorates the name and fame of Dr. Patrick Russell, a distinguished savant, and the pioneer of all snake research work in India, both in its zoological and toxicological aspects. He was born in Edinburgh in 1726, and came out to India in 1781. Four years later the Honourable the East India Company appointed him their naturalist. He is responsible for a monumental work on the Indian snakes, with excellent coloured plates, in two volumes, published in 1796 and 1801. The association of his name with this common snake, renowned as much for the beauty of its colour and ornamentation, as for the deadly character of its bite, is a fitting tribute to his classical work.

History.—First introduced to scientific notice by Russell who figured it in his first volume in 1796 (Plate VII.) and also in his second volume in 1801 (Plate XXXII.). It received its official baptism from Shaw in 1803.

General Characters.—Head flat, heavy, and triangular. The snout rather short, not declivous, with pronounced canthus, and broadly rounded anteriorly. Eye rather large, with an iris heavily speckled with gold, and a vertical pupil. Nostril relatively larger than in any other Indian snake, open. Neck very much constricted. Body massive, relatively stouter than in any other Indian snake, excepting the python ; cylindrical, attenuating to the neck and posteriorly to the vent. Belly rounded. Tail short, and about one-seventh the total length.

Identification.—The following syndrome will fix its identity among Ceylon snakes : (1) 27 to 33 costal rows at midbody, (2) no large shields on the head, and (3) divided subcaudals. For want of attention to lepidosis several other snakes have been frequently mistaken for it, notably the large-spotted viper (*Trimeresurus monticola*), the common Himalayan viper (*Ancistrodon himalayanus*), the Royal snake (*Zamenis diadema*), the Argus cat snake (*Dipsadomorphus multimaculatus*), Russell's earth snake (*Eryx conicus*), and even the python (*Python molurus*).

Colouration.—The ground colour is brown of varying shades, most specimens being a sandy hue. The markings vary much in detail and intensity as well as in hue. Sometimes they are so obscure as to attract little attention, and this is especially so just before desquamation. The sloughing process over, however, the same snake may reveal a definition of adornment and brilliancy of colour, which may renovate it as completely as a mess uniform transforms an officer when exchanged for his khaki. The head has a more or less distinct dark patch on each side behind, a dark streak sometimes picked out with white, pink, or buff, behind the eye, and a dark stripe from the eye to the lip. A conspicuous light line, sometimes white, buff, or pink, runs from above the gape, through the temporal region to the supercilium on to the ridge just referred to on

the snout. These lines converge, and usually meet on the snout to form a V. The lips are white, whitish, or pink, variegated with spots, specks, or streaks.

The dorsal adornment consists of a triple series of about 23 to 30 large ovate spots, forming a vertebral and two costal necklaces or chains. It is not infrequent to see some of these spots more or less confluent, in fact, it is rarely one sees a perfect rosary. The costal spots are frequently interrupted at their lower margins, and sometimes taper, reminding one of a baloon. I have seen a specimen from Kotagiri (5,700 feet) in the Nilgiris in which the three series of spots are completely confluent into bands. The sinuous outlines of these bands indicate the number of spots, which, however, are broadly blended, in the entire length of the snake. It is the only one I have seen so marked. Each spot may be of uniform colour throughout, but more often exhibits a light central zone, similar to the ground colour, which merges into a deep Lincoln-green, purple, or black, around which again may be seen a narrow zone of buff or pure white, the latter especially enhancing the beauty of the specimen. Mr. Millard tells me that about Bombay adult specimens do not have this white definition to the spots, and he is inclined to regard it as a distinct variety. I have satisfied myself that specimens are to be met with in most parts, including Bombay, with and without this white adornment. To begin with, I found in some hatchlings of the same brood, born in the Bombay Natural History Society's Museum, and preserved in spirit, some individuals with and some without the white delineament. In a mother from Saugor, the spots had no light margins, though the single embryo had spots picked out with pale buff.

The belly is white, whitish, or yellowish, with darkish semilunes distributed sparsely and disposed at the margins of the ventrals, especially in the anterior part of the body.

Habits.—(*a*) *Haunts:* It may be met with almost anywhere, except, I believe, in dense jungle, but it prefers open country into which the sun can penetrate and shed its agreeable warmth. Here it lies quietly amongst the vegetation, in lazy apathy, apparently oblivious of its surroundings, but

never, however, relaxing a vigil which has for its reward the capture of the incautious animal that strays within reach. In the evening it bestirs itself and roams abroad while darkness prevails.

Fayrer remarks on the authority of his snakeman that it will take to water, and Haly mentions one swimming in the middle of a backwater. These are exceptional instances. Tennent says that it will climb trees, and I can confirm this as a rare event. Its ungainly proportions, however, do not favour scansorial achievements. It is no uncommon event to find it in close proximity to and even in habitations, and its partiality to a murine diet sufficiently explains such intrusions. I remember one captured in Rangoon beneath the steps of the Cantonment Magistrate's Court during the day where crowds of natives had assembled. Bassett-Smith mentions it as frequently coming into the precincts and into the Naval Hospital at Trincomalee, and Tennent says the Judge's house at this same station became so infested with this species that the family had to quit.

(*b*) *Disposition:* No observer can speak with greater authority than Fayrer, and he says of the Daboia: "In confinement it is sluggish, and does not readily strike, unless roused and irritated, when it bites with great force and determination. When disturbed it hisses fiercely, and when it strikes does so with much vigour." This is entirely my own experience. It is a creature slow to wrath, contenting itself, under moderate provocation, with a loud sustained and warning hiss, reminding one of a leaking football bladder.

A good example of its disinclination to bite is related by Blanford: a friend of his once carrying one home, under the belief that it was a python, until undeceived by its biting and killing one of his dogs. It made no attempt to bite or injure him, though apparently he did not take any precautions in his manner of handling it. Again, Fayrer says he always during his experiments had the greatest difficulty to get this snake to bite voluntarily. I can fully confirm this, frequently rats put into its cage remain there alive and unmolested for days. In making these remarks, however, I think one must expect many exceptions to this attitude of indifference.

Young specimens especially seem more on the alert, more easily alarmed, and are correspondingly more easily provoked to bite than many adults.

The bite is sometimes inflicted by a snap, the creature relaxing its hold at once. On the other hand, it is not unusual for Russell's viper to bite, and maintain a tenacious grasp for many seconds. In the case of a gunner who succumbed to the bite of this snake at Thayetmyo (Burma) in 1862, Nicholson mentions that it was with difficulty shaken off. Elliot mentions a dog bitten by one, dragging the snake many yards before disengaging it, and one might quote many more similar experiences.

(*c*) *Striking Posture:* It will not strike till considerably irritated, when it hurls itself at the offending object with determined malice. I have known one spring with such a powerful muscular effort, that I believe it actually left the ground in its endeavour to strike me.

(*d*) *Nocturnal or Diurnal:* It is decidedly nocturnal in habit. In the daytime, when encountered, it is generally found lying coiled in grass, but at night it is frequently met on the move crossing roads, and its intrusion into dwellings usually occurs under cover of darkness.

(*e*) *Progression.* Its movements are slow, and consistent with its corpulent habit. When disturbed, it prefers usually to maintain its ground, and frequently will contest the right of way with heaving sides and angry hiss. When it does retire, it does so in a leisurely manner befitting its dignity and figure. I have never seen one move faster than a crawl.

(*f*) *Hissing:* The hiss once heard is not easily forgotten; no other snake emits such a volume of sound, to the production of which two factors contribute. Firstly, the size of the lung which is developed to a degree commensurate with the remarkable body girth; and, secondly, the large size of the nostril, for it is through this aperture that the sound is produced. In Bangalore I experimented with a large adult belonging to a snake catcher. Among his stock-in-trade he carried the familiar gourd pipe used by this fraternity. This was sealed up in places with cobbler's wax which I removed, rendered pliable by heat, and packed into the daboia's nostrils.

This done the snake was unhanded and irritated. It was then noticed that the lung expanded with difficulty, and very imperfectly, and hissing was no longer feasible.

(*g*) *Sloughing:* One caged in the Madras Museum desquamated on June 16, July 31, October 6, and December 27. Mr. D'Abreu tells me that one confined in the Nagpur Museum for 167 days only cast its skin once. Another in the same institution captured on September 7 exfoliated on September 10, on March 20, and June 28 of the following year. For some days before the period of ecdysis the snake is purblind, and, as a result, many specimens are killed or captured while so handicapped.

Food.—All my observations go to show that small mammals, and especially rats, constitute the main diet of the daboia, but it is not so bigoted in gastronomic matters as to be disdainful of other fare. Mr. E. E. Green found one that had eaten a green lizard (*Calotes ophiomachus*) as well as a rat. In captivity, Mr. Spence tells me, the specimens caged in Bombay feed better than any other species. One in the Madras Museum ate 5 squirrels and 27 rats in 1896. Another young specimen ate 5 squirrels, 2 rats, 67 mice, and 4 frogs during its captivity the same year. Mr. D'Abreu tells me a caged specimen at Nagpur ate rats, squirrels, mice, shrews, kittens, small birds, such as sparrows, owlets, and swifts, and also sometimes bloodsucker lizards (*i.e. Calotes*) and frogs. Some specimens do not feed well in captivity. Dr. Davy had one in captivity for 146 days that refused all food, and Fayrer had one that neither ate nor drank for a whole year, but still retained its vigour and poisonous activities. I know of no snake-eating tendencies in adults, but cannibalism seems a common offence among the young. Major Dawson writes to me that on one occasion when young daboias were born in the gardens at Trevandrum, "the young commenced to devour each other," and on another occasion in the same place "one of the young swallowed one of its fellows, and in about a quarter of an hour disgorged it," and both, at the time of writing, were alive and well. Father Dreckmann, too, told me of a similar experience among a brood in captivity; he says "when I inspected the young family one morning, I found

one of its members dead, and another one missing, and on examining the dead one I found the missing one inside him."

Breeding.—(*a*) *The Sexes:* Females in India appear to be more numerous than males. Thus, out of 71 young born at Parel, the aggregate of two broods which were submitted to me, I found 25 were males and 46 females. In a Ceylon brood of 26, 12 were males, 13 females, and 1 damaged unsexable. From the same three broods it would appear that males are a trifle longer at birth than females. The bodies in the sexes are relatively of equal length, but the tails in males are relatively longer. The male claspers are bifid. The main stem is short, and the limbs are beset with large subcylindrical cartilaginous white processes distally; the proximal part of the limbs and the stem being studded with minute recurved hooks. In the invaginated state the clasper tube is seen to bifurcate, and the two limbs to rejoin later. It is this peculiar condition which causes the extruded organ to be bifid. The secretion from the anal glands is custard-like, with an orange tinge.

(*b*) *Method of Reproduction:* It is viviparous in habit. Often unfertilized eggs are discharged at the same time as the young. At first the fertilized eggs are enveloped with the same soft white coriaceous investment that one sees in oviparous snakes. This envelope in course of time metamorphoses, until, in the latter stages of pregnancy, it is converted into a delicate transparent membrane. Usually this membrane is ruptured within the mother, and the young escape alive, but it is not at all unusual for some of the sacs to be discharged as such, and the young are born in a caul, within which they frequently perish unless speedily liberated. This metamorphosis of the investment does not occur in unfertilized eggs, and this has given rise to reports that this viper is both oviparous and viviparous. The sacs containing the young in one instance measured 43 by 20 mm. ($1\frac{5}{8}$ by $\frac{3}{4}$ of an inch). I found one sac 53 mm. ($2\frac{1}{20}$ inches) in length.

(*c*) *Season:* The sexes seek one another's company for matrimonial intercourse during the months of December to May. A male killed at the end of December at Cannanore was reported to have been "in copula" when encountered.

The female escaped. I have collected over thirty records from various sources, including my own notes, and find that females in various stages of pregnancy have been killed in every month of the year. Mr. Green killed a female in Ceylon in December containing small eggs. Mosse had a similar specimen in March at Guzerat. I had a similar specimen at Trichinopoly in April, and another in May. One killed in Ceylon on July 28, 1915, held 30 eggs rotund in form, and about 12 by 12 mm. (½ by ½ an inch). Young in various stages of growth have been seen right up to November.

The young are born from May on to November, much the most usual months being June and July. I have had many specimens less than 305 mm. (1 foot) long brought to me between May and September at various times.

(*d*) *Period of Gestation :* This is definitely known to exceed six months. Bannerman reported that a female acquired on December 6, 1905, gave birth to her young on June 21, 1906, at Parel (over 197 days). Narayan Rao recorded the birth at Bangalore on June 8, 1917, of a brood. The dam in this case was acquired in the first week of December.

Growth.—(*a*) *The Young :* When born the young measure from 200 to 280 mm. (7⅞ to 11 inches). I believe the low measurements, sometimes recorded, are the result of the artificial conditions of life in the vivarium, and that in specimens living under natural conditions the progeny reaches a length of 250 to 280 mm. (10 to 11 inches) before birth. The two specimens submitted to me from Narayan Rao's brood, where the dam had been over six months a captive, measured 200 and 212 mm. (7⅞ and 8⅜ inches).

Members of the same brood vary a little in length. The 71 young born of two broods at Parel, and carefully examined by me, the males measured 230 to 260 mm. (9 to 10¼ inches), and the females 215 to 255 mm. (8½ to 10 inches).

When born the young show much more activity than adults. They strike out boldly at any offending object, and I have witnessed one attack and bite a mouse, which succumbed in a few seconds, showing that the poison is active from the time of birth. Similarly, Dr. Shortt saw a young daboia only 215 mm. (8½ inches) long kill a young partridge weighing 9½

tolas in ten seconds. They frequently attack and swallow one another. They do not thrive for long in captivity, but very speedily die as a rule.

This is one of the most prolific of the Indian snakes, only being equalled or surpassed in fecundity by the python (*Python molurus*) and the chequered keelback (*Nerodia piscator*). It frequently produces from thirty to forty young in one brood, and as many as sixty-two and sixty-three have been recorded. I once found only a single fœtus, and I have several records from one to less than twenty.

(*b*) *Early Life:* The growth is difficult to ascertain with certainty, as the season for the production of the young is so protracted. They probably double their length in the first year of life, and treble it by the end of the second year.

(*c*) *Maturity:* The smallest gravid female in my notebooks was 1,015 mm. (3 feet 4 inches) long, and I think would be about 3 years old.

(*d*) *Maximum Length:* Specimens over 1,220 mm. (4 feet) are not uncommon, but over 1,525 mm. (5 feet) are rare. I measured a stuffed specimen once 1,600 mm. (5 feet 3 inches). Fenton has recorded one 1,640 mm. (5 feet 4½ inches), and Brook-Fox two which taped 1,675 mm. (5 feet 6 inches).

Poison.—(*a*) *The Fangs:* These attain their maximum development in this the largest of the Indian vipers. I have one 16 mm. (over half an inch) measured with compasses from base to point, and the curve would probably account for another mm. This was from an average adult. There are two fixed side by side. In a depression at the back, as many as 5 or 6 reserve fangs may be seen lying loosely in the mucous membrane, progressively diminishing in size from within outwards. When one of the fangs is shed, the reserve fang, best developed and lying nearest to it, becomes cemented in a few days into the jaw.

The fang is tubular, being formed by the folding over of two lateral expansions of the tooth, which blend on its anterior face, in the major part of its length. A groove which is feebly discernible, but always present, marks the line of junction of these two expansions. At its base the expansions fail to meet,

and the imperfect blending is marked by an aperture. The canal terminates near the point of the tooth in a minute opening.

The fangs in vipers are very mobile, or to speak more correctly, the maxillæ are, for the fangs are fitted into these bones. Russell's viper, like other vipers, when it yawns, frequently rocks its maxillæ forwards and backwards.

(*b*) *The Glands :* These sacs, compared with the cobra's, are small and present a corrugated appearance unlike the smooth retort-shaped glands of the cobra. Wall (A. J.) mentions a supplementary gland in this viper, globular in form, which completely surrounds, and empties itself into the ducts draining the major sac.

(*c*) *Physical Characters :* Lamb tells us that this venom is clear, with a small quantity of undissolved material in suspension. Its reaction is acid. The taste resembles gum acacia. In drying it cracks into longitudinal fissures, yielding needle-shaped fragments. The dried product retains its toxic properties indefinitely, and is readily soluble in water.

(*d*) *Yield :* Acton and Knowles obtained 145 mgms. of the dried product from an adult 1,015 mm. (3 feet 4 inches) long. Elliot expressed eleven drops from the two glands of an adult.

(*e*) *Amount injected at one Bite :* This has been estimated by Acton and Knowles as about 72 mgms. of the dessicated poison, which is considerably in excess of the lethal dose for man.

(*f*) *Toxicity :* When swallowed daboia venom has no more deleterious effect on the system than cobra poison, but, of course, one must postulate a healthy and unbroken surface in the mouth and further passages. Elliot gave 11 drops to a goat, and a larger quantity to a dog, without noticing any ill-effects. Absorbed into the blood stream, Acton and Knowles find it is less than one-third as toxic as cobra venom to monkeys.

(*g*) *Lethal dose for Man :* Acton and Knowles, postulating a susceptibility in man equal to that of monkeys upon which they experimented, estimate the fatal dose for a man at 42 mgms., or about four-sevenths the approximate dose delivered at one bite.

(*h*) *Uncertainty of Effects:* As in the case of other poisonous snakes, it does not, in the least, follow that a serious bite will cause death if left untreated. There is abundant evidence to show that a percentage of cases, hard to determine, do not die even though the local injuries are such as to warrant the gravest apprehension. No more instructive record on this score is to be found in snake literature than that quoted by Elliot. He says: "I myself saw a large powerful daboia (3 feet 8 inches long) strike fairly at a dog, hold it, shake it, and only let go when the dog had fled yelping several yards, dragging the snake along the ground. The part bitten was soft and fleshy, the bite was apparently a fair one, the glands of the snake, when dissected, though emptier than usual, both proved to contain poison. From one gland alone I obtained more poison than another daboia emitted through a leaf in a vigorous bite. Add to all this that there was a well-marked subcutaneous extravasation round the bite, and the case seems perfect . . . though it became rather ill, did not die. Eight days later the same animal was fairly struck by a vicious daboia (3 feet 4 inches long), the bite being almost instantaneous in its shortness, and this time the victim died in less than three hours."

Haly mentions a bite from this snake, from which the man suffered no ill-effects.

(*i*) *Toxins:*—

(1) Toxins operating on nerve cells—

(*a*) A depressor paralysing the vasomotor centre (Rogers).

(*b*) A depressor to nerve cells generally.

(2) Agents affecting the constitution of the blood—

(*a*) A fibrin ferment clotting the blood (Lamb).

(*b*) An antifibrin ferment reducing the clotting power of blood (Cunningham, Lamb).

(*c*) "Hæmolysin" destructive to red blood cells (Cunningham, Lamb).

(*d*) "Leucolysin" destructive to white blood cells (Cunningham).

(3) "Hæmorrhagin" destructive to the lining membrane of blood vessels (Cunningham).

(4) A depressor to cardiac muscle (Lamb).

(5) A vaso-constrictor (Rogers).

(6) "Cytolysins" destructive to (*a*) liver, kidney, and testis cells (Flexner and Noguchi), and (*b*) to tissue cells at the site of the wounds.

(*j*) *Analysis of toxic action*—

(1) (*a*) The depression of the vasomotor centre is seen in the reduction of blood pressure, and cardiac weakness culminating in early death.

(*b*) The depression to nerve cells generally explains the great depression of spirits and reduced vitality in daboia poisoning. It is not sufficient to produce paralysis.

(2) (*a*) In large doses blood clots firmly within the vessels, and convulsions, ending in death, occur almost immediately. The daboia cannot inject sufficient venom into the human subject to bring about this effect, which is only seen in relatively small animals injected with very large doses.

(*b*) In moderate doses a contrary effect is produced in the blood, and this, in conjunction with (3), accounts for the hæmorrhages which so frequently occur.

(*c*) "Hæmolysin" is potent in this venom and still further lowers the general vitality induced by (1) (*b*). It also has some effect in embarassing the respiration.

(*d*) Reduces the normal resistance to microbic invasion.

(3) "Hæmorrhagin," by damaging the lining membrane of the arterioles, favours leakage of the vessel contents. In conjunction with (2) (*b*) hæmorrhages are frequently the result.

(4) In conjunction with 1 (*a*) this causes heart failure.

(5) A vaso-constrictor has been demonstrated by Rogers. By reducing the calibre of the blood vessels, blood pressure would be raised and the heart reinforced. Any tendency towards such action appears to be nullified by a more potent element operating on the vasomotor centre, viz., 1 (*a*).

(6) Causes sloughing locally with the formation of an ulcer.

The venom is three to five times less potent than cobra venom according to Lamb.

Its action upon the blood is as follows: A toxic body (hæmolysin) destroys the red blood cells. whose function it is to carry oxygen to the various tissues. As a result all vital processes are lowered. Another toxic principle (antifibrin ferment) very profoundly alters the consistency of the blood, and reduces its clotting powers. The action of this latter principle is exactly that of citric, phosphoric, oxalic, and other acids, and is, probably like them, due to a precipitation of the calcium salts in the blood. This in itself does not account for the transudation that occurs; but the fact that the lining membrane of the walls of the blood vessels themselves are damaged by another toxic element (hæmorrhagin) renders them more permeable. The effect of these two toxins is seen in the great tendency to hæmorrhages which are characteristic of the Viperine class of poisons. These hæmorrhages may be visible or invisible, and the whole case may imitate scurvy or purpura, diseases mainly characterized by similar blood changes. It frequently happens that the fang punctures continue to bleed or discharge bloody serum, or having stopped, bleeding recommences some hours or even days later. There may be bloody discharges from any mucous orifice. Invisible hæmorrhages* in the abdomen may cause pain, tenderness, and vomiting, recalling to the

* These are specially well exemplified in the cases of *Echis* poisoning referred to later.

physician's mind the identical state of affairs one sees in Henoch's purpura. Similarly, there may be extravasations into joints, or other serous cavities, which may become painful and swollen, reminding one of another clinical condition, viz., arthritic purpura. Hæmorrhages are apt to occur under the skin, producing port wine discolourations in the form of spots or patches of various sizes, or they may occur in muscles and other tissues, giving rise to painful and tender swellings.

Death due to cardiac failure, induced by toxins (1) (*a*) and (4), or later on to exhaustion, may occur in from 1 to 14 days, or even longer.

(*k*) *Symptoms:* Daboia poisoning may be taken as the type of Viperine toxæmiæ.

Experimentally in animals three forms of toxæmiæ are observed.

It was observed by A. J. Wall, Fayrer, and others experimenting on animals that when the dose of poison was large, rapid and violent convulsions were induced, resulting in death from asphyxia in a few seconds or minutes. Lamb was the first to correctly interpret these phenomena. He found that daboia venom contains a ferment that coagulates blood. This ferment is only operative in highly concentrated doses of poison. It causes clotting of blood inside the blood vessels, and to this is attributable the convulsive seizure and death from asphyxia. He further showed that the dose necessary is so large that it is very unlikely that this mode of death would ever be seen in the human subject.

The other two forms of toxæmiæ, one acute the other subacute or chronic, are to be met with in the human subject. In the *acute* form there is general depression, in which the vital functions connected with both the heart and respiration are profoundly affected. The pulse becomes rapid and weak, and breathing rapid and irregular. General weakness of the muscular system is seen, and the mental activities may be reduced to the degree of unconsciousness. Nausea and vomiting are frequent, and the pupils become dilated and insensitive to light. The surface temperature is reduced, and

the skin is cold and often bedewed with sweat. There are no paralyses such as we see in Colubrine toxæmiæ. Concurrently with these effects on the nervous system, others depending on the altered state of the blood are most likely to be exhibited, as bleedings from various mucous orifices, or beneath the skin, or invisible hæmorrhages into serous cavities. The watery state of the blood may occasion œdema in dependent parts, or in organs, especially the lungs. Death from cardiac or respiratory failure may terminate this toxæmia, or these symptoms may decline, and the patient appear as if about to recover. A repetition of the above may occur, or recovery may pass on to the third form of toxæmia.

The *sub-acute* or *chronic* poisoning appears to be connected with the local state of the wounds, which, from the intensely virulent nature of the poison, are very apt to be seen in a sloughing condition, favouring the development of septic germs. In the course of a few days, added to the general depression, emaciation sets in and anæmia, which will depend in degree largely upon the extent of the hæmorrhages. The enfeebled state of the system can oppose little resistance to the effects of invasion of any germs into the local wounds, and various forms of blood-poisoning, including tetanus. may result. Diarrhœa may occur, albumen appears in the urine, and the patient ultimately dies of exhaustion from hæmorrhages, or from blood-poisoning, the effects of invading germs that have gained entry into the local wounds. This state of affairs, however, need not necessarily prove fatal.

*Local Signs of Daboia Poisoning.**

The local effects in daboia poisoning are usually very severe. Extravasations of blood are likely to occur in the neighbourhood of the punctures, the various tissue cells are destroyed by the virulence of the poison, and a slough forms, which when separated leaves a deep ragged ulcer.

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* The signs are seen in most cases of Viperine poisoning, and to a less degree in Colubrine poisonings of every kind.

(1) *Pain:* Where venom has been injected pain is an almost certain symptom. It is burning or stinging in character, often extremely acute, and it comes on immediately. It is possible that the stings of certain other creatures, such as scorpions, spiders, hornets, &c., might be as severe, and as rapidly produced; but if pain is experienced only to the degree normally met with in ordinary wounds from mechanical agency, it is highly probable that poison has not been introduced. The pain due to the poison may be masked by that produced by surgical interference, that evoked by local remedies of a caustic nature, such as acids and permanganate of potash, and also that occasioned by ligatures which is usually very distressing.

(2) *Swelling:* Snake venom is an extremely powerful local irritant, and as such causes swelling in the injured part almost at once, similar to that seen after the bite of a mosquito. Swelling to an equal degree, and as rapidly manifested, might result from insect or scorpion stings. If, however, no trace of swelling accompanies the wound, there is good reason to consider that no poison has gained entry, and the longer the interval since the bite the greater the justification for assuming a non-venomized wound.

(3) *Bleeding:* One of the chief effects of snake venom, whether Colubrine or Viperine in quality, is its power of reducing the coagulability of the blood, and this fact affords very valuable information as to whether or not venom has been introduced into a wound, since when it has gained entry a constant oozing of thin bloody serum results, which often continues for many hours. In a case recorded by Lamb and Hanna this continued for 24 hours. If lacerations or punctures are seen sealed up with blood within a few minutes of the casualty, as in the case of ordinary wounds, there is very strong justification for believing that no poison has been injected.

(4) *Tissue Changes:* Should the presence of any of the above local conditions call for local operative measures, the

condition of the tissues as revealed by incision, will furnish confirmatory testimony of the entrance of snake poison, which, in the opinion of my namesake, A. J. Wall, is absolutely characteristic. He says the areolar tissue becomes purple in colour and infiltrated with coagulated purple blood-like fluid. This fades gradually to a pinkish colour, and this again to normal conditions as the site of the poisoned wounds are receded from. These changes are extremely rapidly produced, having been seen by this authority within 30 seconds of the entrance of the poison.

To the surgeon this sign is invaluable. Its presence proclaims the envenomed nature of the wound, and dictates a course of action completely different from that necessary in its absence.

(5) *Discolouration :* A greenish or bluish tinge is frequently observed in the skin in the immediate neighbourhood of the punctures within a few minutes of the bite when venom has been introduced. Sometimes, indeed, the skin is purplish from severe subcutaneous bleeding.

(6) *Sloughing :* The tissue cells in the vicinity of the wounds frequently die as a result of the powerful action of the poison. The result is the formation of a slough varying in extent to the dose of the poison injected. This dead matter under normal constitutional conditions offers an ideal pabulum for putrefactive germs to flourish. But in snake poisoning, among other things, it has been shown by Ewing, that the natural germicidal properties of blood are rendered inert, so that with the entry of germs there is a grave danger of another form of blood poisoning to be set up, and death may be the result of an intoxication from such germs. When the slough separates, a deep ulcer is left which takes some time to heal.

(7) *Illustrative Case :** A case of daboia poisoning, by W. R. Taylor, M.R.C.S. (Eng.), L.R.C.P. (Lond.).

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* Appeared in the "Indian Medical Gazette" for September, 1919, p. 337.

Casualty Return.

Station ..	.. Insein, Lower Burma
Sex ..	.. Male, Burman
Age ..	.. 30
Date and hour of bite	.. May 29, 1919, about 7 P.M.
Hour of admission	.. About 9 P.M.
Part bitten	.. Outer side of dorsum of left great toe at the base
Species of snake	.. Russell's Viper, 36 inches without head
Result ..	.. Cure

Symptoms, Local.

(*a*) Pain	.. Intense and immediate
(*b*) Swelling	.. Immediate
(*c*) Sanious oozing	.. Only after incision
(*d*) Appearance of cut tissue	.. Œdema and local discolouration over an area, the size of a 2-anna bit
(*e*) Characters due to mechanical causes	.. One puncture only

Symptoms, General.

(*a*) Consciousness	.. Stated to have been temporarily unconscious after reaching his house
(*b*) Respiration	.. Shallow and somewhat hurried
(*c*) Syncope, Pallor	.. Pallor marked, pulse 120, skin moist, cold, and clammy, vomiting set in before admission and continued (see notes)
(*d*) Paralysis	.. Nil
(*e*) Hæmorrhage	.. Vomiting of blood, subcutaneous hæmorrhage
(*f*) Other symptoms	.. (See notes)
(*g*) Treatment	.. Antivenene (see notes).

Clinical Notes.

May 29, 1919.—The patient was an intelligent English-speaking Burman Christian, living about three miles from the hospital. He states that he was bitten about six furlongs from his house. His companion cut off the snake's head, and

the body was brought to me. The Russell's viper is well known locally, and both men knew quite well what it was. The victim himself tied a ligature of cord round his leg, below the knee, and walked to his house. He was then brought to hospital, in a bullock-cart, by an old missionary lady of 80, who sat up with him all night, and mounted guard subsequently to ensure rejection of the innumerable offers of remedies and charms brought by his visitors. It was, therefore, at least two hours after the bite that I saw him.

He was in very great pain, and the leg was much swollen up to the level of the cord. There was a small (2-anna bit size) area of discolouration around the puncture, but apart from a congested appearence, probably due to the ligature, no discolouration of the leg. He was sweating, but his skin and extremities were cold ; respiration shallow, 26–30 ; pulse 120, feeble. It was noticeable that in spite of the general condition and feeble pulse the superficial veins of the limbs were full. Pupils normal, and no sign of any paralysis.

I immediately injected 20 cc. Kasauli antivenene intravenously and 20 cc. subcutaneously under the skin of the abdomen. I then made a crucial incision over the puncture and applied permanganate crystals. I did not consider this procedure likely to be of benefit, and it certainly increased the pain, but it was obviously expected of me. The incisions were superficial and the tissues, except for the dark area mentioned, appeared to be merely œdematous. One cc. pituitrin was also given. Vomiting occurred twice shortly after admission, the vomit consisting of blood and mucus only, about 4–6 oz. of blood on each occasion. It had also occurred several times before admission. The ligature below the knee was then removed and a tourniquet applied above the knee, a brief interval being allowed without appreciable effect. Half an hour later, although the pain was just as severe, the general condition was improved and the pulse considerably stronger. At 10 P.M. the condition was distinctly good, and no further vomiting had occurred. The tourniquet was now relaxed, and relaxation having no effect it was removed altogether. At 11 P.M. although no new symptoms

had appeared, I considered his condition distinctly worse than it had been an hour previously, and I therefore injected subcutaneously the remaining 20 cc. antivenene. Within half an hour his condition had again improved very considerably, and about midnight I left feeling satisfied that there was no immediate danger. Adrenalin was held in reserve for any further hæmorrhagic symptoms, and calcium lactate, 30 grains, given by mouth and continued, t.d.s., to a total of 180 grains.

May 30, 1919.—Morning, 14 hours after bite : Temperature 99·4°, pulse 120, general condition good, but pain still severe and patient had had no sleep. Local condition considerable oozing from incisions, soaking through a thick dressing. Foot somewhat discoloured, swelling extends above the knee, and is obviously increasing.

Evening, 24 hours after bite : Temperature 99·6°, pulse 120, general condition good, still in great pain and restless, but no sign of onset of delirium or convulsions. Paraldehyde, one drachm, given.

May, 31, 1919.—Morning, 36 hours after bite : General condition good and pain diminished, had a fair night. The leg and thigh are now enormous, and patches of subcutaneous hæmorrhage are seen, especially where ligature and tourniquet were applied. On the tense swollen leg the patches of discolouration resemble *post mortem* staining.

The patient's condition subsequently gave rise to no anxiety, but the œdema extended over the lower part of the back and abdomen and discolouration appeared on the hip and gluteal regions.

He was discharged on the 13th day, his leg being still much swollen.

One other point of interest was noted by Mr. P. A. K. Chari, S.A.S. On the second day the patient begged for and was granted a cigarette, one inhalation from which was immediately followed by definite faintness. The patient, however, was not convinced as to the cause, and later in the day repeated the experiment, under close observation and with the same result.

Comments.

The antivenene was supplied to me twelve months before use, with a note to the effect that it was then one year old, but had been kept in cold storage. Personally, I am convinced that the antivenene saved the patient's life. It may, of course, be argued that he did not receive a lethal dose, and perhaps the fact that only a single puncture was found favours this view. On the other hand, it cannot be denied that a Russell's viper of over 36 inches can, and usually does, inject a fatal dose. Moreover, the improvement which followed the injection of antivenene on each occasion was very marked and cannot be attributed to any other cause.

Comments by Author.

The report on this case is exceptionally valuable as the snake that inflicted the injury was killed and brought in. It was identified as a Russell's viper by my old friend Colonel G. H. Evans, so there can be no doubt on this score.

The fact that so severe a degree of syncope was observed within two hours of the bite, coupled with the recurrent hæmatemeses which occurred even earlier, proves that a considerable dose of venom must have been discharged into the tissues.

I believe it is very unusual for hæmorrhages to appear so rapidly. I know of no case that proves the value of antivenene more conclusively.

It is dubious if calcium had any action in this case, or if the cessation of hæmorrhages was entirely due to the antivenene. It seems to me unlikely, however, that antivenene can restore to the blood its lost clotting power or repair damage to the intima. This is a matter that could be demonstrated in the laboratory. It is an important point to clear up in the treatment of these cases. It is conceivable that leakage from vessels might continue after antivenene has neutralized the venom in circulation, and a case might still be lost unless agents like calcium and adrenalin are made use of (F.W.).

(*m*) *Interval before Death:* This, of course, depends upon the dose injected. There are records of death following the bite in from 15 minutes to 14 days or more. Mr. Vernede told me of a cooly woman who was bitten by a large Russell's viper, judged to be 5 feet long, on his estate in the Nilgiris in 1917. In ten minutes from the casualty she was brought in a comatose state for treatment, and within fifteen minutes of the accident was dead. It is difficult to say positively if this was to be attributed to the toxæmia, or to fright acting upon the heart. However, Acton and Knowles* say, though exceedingly rare in the human subject, cases of pulmonary embolism do occur, and it is possible this fatality may have been due to this cause. Usually death from the acute form of poisoning, due to syncope or exhaustion from hæmorrhages occurs in from a few hours to a few days. The chronic form, leading to septicæmia, may cause death as late as two or three weeks after the casualty.

(*n*) *Treatment recommended:* The one certain remedy is antivenene, and 40 cc. of this serum should be run into the veins as early as possible, and repeated if the symptoms do not abate within half an hour, or in extreme cases even less than that time.

As syncope due to emotional causes is to be expected in all cases of ophitoxæmia, this should be treated on the lines suggested under the treatment of cobra poisoning. It is to be noted that antivenene may successfully neutralize the poison in circulation and the case still be lost, if syncope due to emotional causes as well as to the toxæmia is not vigorously treated. Bayliss' fluid is specially to be advocated intravenously until normal blood pressure is re-established. It consists of gum arabic 7 parts, sodium chloride ·9 parts, and water 92·10 parts, and it must, of course, be sterilized. Again it is to be noted that hæmorrhages must be controlled, and suitable remedies employed with this object. Antivenene may successfully achieve its purpose, and a case still be lost from hæmorrhages.

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* Ind. Journal of Medical Research, 1914, Vol. 2, No. 1, p. 95.

The drug recommended is chloride of calcium ($Ca\ Cl_2$)* which should be employed as follows. One grain of $Ca\ Cl_2$ to twenty minims of water should be injected deep into the gluteal muscles, and acts like a charm in various hæmorrhages. *Caution.*—The same injection hypodermically causes local gangrene and also considerable pain. This injection might be repeated once, but the fact that an injection of ten grains of the salt set up a terrible femoral thrombosis in one case, shows that the drug intramuscularly must be given with caution.

Other remedies to which an appeal may be made are adrenalin and pituitary extract, both drugs specially suitable as they reinforce the heart, as well as control hæmorrhage.

The triple alliance then of antivenene, Bayliss' fluid, and $Ca\ Cl_2$ are the measures upon which the greatest reliance should be placed.

Parasites.—(*a*) *Entozoa:* Von Linstow has identified a nematode or round worm (*Kalicephalus willeyi*) from the stomach, and œsophagus of Russell's viper. I have frequently found small nematodes about half an inch long attached to the gastric mucous membrane which may prove to be the same parasite.

Lepidosis.—*Typical—Rostral:* As broad as high; in contact with six shields; the rostro-nasal sutures longest. *Supraoculars:* Large; undivided. *Nasals:* Large; entire and peculiar in shape. A vertical pillar-shaped portion forms the anterior boundary of the nostril. This bifurcates above to receive the anterior extremity of a crescentic supranasal shield. The nostril lies between two fissures, one above and the other below, both of which nearly extend to the margin of the shield. *Supralabials:* Ten to twelve; 4th largest; the 1st touching the nasal, none touching the eye, being separated by two or three rows of subocular scales. *Sublinguals:* One

* *Vide* "The Indian Medical Gazette" for June, 1919.

pair ; touching four or five infralabials. *Infralabials* : Five ; the last largest and in contact with two scales behind. (Fig. 91.)

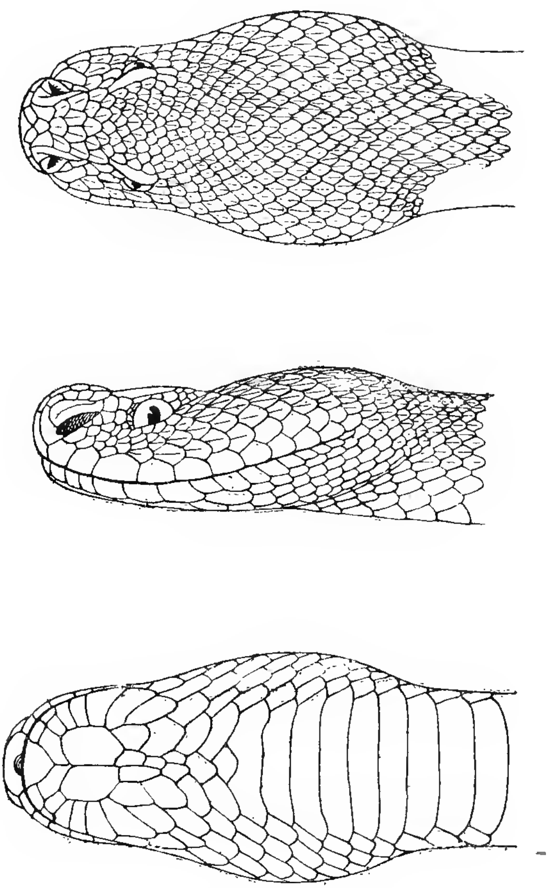

FIG. 91.—Vipera russelli.
(Life size.)

Costals : Longer than broad, rectiform, strongly keeled with paired apical facets. The keels in the last row, where present, are oblique. Vertebrals not enlarged ; the breadth of the scales less than half their length, and less than half the breadth

of the ultimate row. Ultimate row enlarged; the breadth of its scales greater than their length. In 25 to 27 (rarely 29) rows two heads-lengths behind the head, 27 to 31 (rarely 33) at midbody, and 23 to 21 two heads-lengths before the vent. *Supracaudals:* In even rows, all keeled to tail tip. *Ventrals:* 153 to 176; rounded. *Anal:* Entire. *Subcaudals:* 41 to 64: divided.

Dentition.—*Maxillary:* Two large, canaliculate fangs placed side by side. *Palatine.* 3; isodont, and placed in the middle of the bone with a considerable edentulous space anteriorly and posteriorly. *Pterygoid:* 9 or 10; isodont, or slightly scaphiodont; more than half the posterior part edentulous. *Mandibular.* 12 or 13; strongly scaphiodont. (Fig. 92.)

Fig. 92.—Maxilla of Vipera russelli. Typical viperine maxilla. Compare with colubrine maxilla of cobra Fig. 89.

Distribution.—(*a*) *General:* Peninsular India to the Himalayas.* In the north-west it extends to Sind, and in the north-east to at least as far east as the Jalpaiguri District. Southern Burma, Siam, Ceylon, the Andamans, and Nicobars (?), Sumatra.

* In my book, "The Poisonous Terrestrial Snakes of our British Indian Dominions," I included the Eastern Himalayas within the habitat of Russell's viper on the authority of Mr. Millar of Darjeeling, who was a reliable observer. Fortunately, I have kept his letter, and referring again to the list he gave me, I find that he included Russell's viper on the authority of a friend from Kurseong. I have now no hesitation in removing the Eastern Himalayas from its range of distribution, and feel sure that the friend mistook a large-spotted viper (*Trimeresurus monticola*) for Russell's viper as so many others have done.

(*b*) *Local :* It is a denizen of the plains, but flourishes at a considerable altitude. Dr. Henderson told me that he had met with it in the Palni hills up to 7,000 feet, and in the Nilgiris up to 6,000 feet. I found it quite common in the Western Himalayas (Almora) at 5,000 feet and over, and Stoliczka reported it in Kashmir up to 6,000 feet. I have had specimens from Hakgalla 5,700 feet.

In parts of India it is extremely common, and in other parts decidedly the reverse. In parts of the Punjab it is specially abundant, and Fayrer mentions that about Umritsar as many as 471 specimens were brought in one day in 1866. It is very common on the west coast of India and the hills in that region. Mr. Millard tells me it is plentiful about Bombay. I found it common at Cannanore, in the Nilgiri hills, and on the Mysore plateau (Circa 3,000 feet). Ferguson reported it common about Travancore State. It is common all over Southern India, and extends in the north as far as Lower Bengal. It is abundant in Burma, and in some parts, viz., Mahlaing, Magwe, and Mayo-thit, it is so plentiful that the natives working in crops wear woven grass shoes as a protection against it. Haly and Ferguson report it abundant in Ceylon, and Tennant and Basset-Smith mention that it is particularly so about Trincomalee. On the other hand, it is extremely rare if it occurs at all about Delhi, and from there all along the Ganges valley to about Behar. I can find no record of it in this area, and in a collection of 704 snakes obtained by me at Fyzabad, United Provinces, not a single specimen was included. In Northern Bengal it is very rare, and it does not appear to extend to Eastern Bengal, nor does it occur in Assam.

Genus ECHIS.

(Greek " echis " viper.)

General Characters.—Small snakes barely reaching 2½ feet in length. Head subovate or pear-shaped ; snout very short, without canthus, obtusely rounded terminally. Eye large, with vertical pupil. Nostril lateral, and placed rather high. Commissure of the mouth depressed opposite the position of the fangs. Neck small. Body stout, cylindrical, attenuating

to the neck and posteriorly ; very rough from the keeled scales. Belly rounded. Tail short, about one-ninth to one-eleventh the total length.

Identification.—The penultimate costal row is peculiar to the genus, in that each scale touches three above, owing to the obliquity of the superjacent rows. The head above is covered throughout with small scales. The subcaudals are entire.

Habits.—Desert snakes, extremely active and vicious ; diurnal.

Food.—Small mammals, lizards, frogs, scolopendræ, and scorpions.

Breeding.—Viviparous.

Poison.—Very poisonous and frequently fatal to man.

Lepidosis.—*Rostral :* Breadth twice the height ; touching six or more scales ; the rostro-labial sutures longest, twice to thrice the rest. *Internasals :* Two, divergent ; in contact with the rostral or not. *Supraoculars :* Many, small. *Nasals :* Entire or divided ; touching or not touching the rostral. *Suboculars :* Two to five rows of scales between the eye and the supralabials. *Supralabials :* Ten to fifteen. *Sublinguals :* One pair.

Costals : At midbody. Median rows rectiform, keeled, the breadth of the scales about two-thirds their length, and half or less than half the ultimate row ; four to seven lateral rows oblique, with serrated keels. Penultimate row rectiform, keeled, its scales as broad as long. Ultimate row rectiform, keeled for a variable extent posteriorly ; its scales as broad or broader than long ; in 25 to 37 rows. *Supracaudals :* In odd rows ; keeled to the tip of the tail. *Ventrals :* 132 to 205 ; rounded. *Anal :* Entire. *Subcaudals :* 21 to 52 ; entire.

Dentition.—*Maxillary :* Two canaliculate fangs placed side by side. *Palatine :* A short edentulous space anteriorly and posteriorly, teeth few, isodont. *Pterygoid :* Isodont, except the last two or three which are reduced. *Mandibular :* Markedly scaphiodont.

Distribution.—North Africa. South Asia as far east as about the 85 meridian.

Only two species are known, one of which occurs in Ceylon, viz., *carinatus*.

ECHIS CARINATUS (Schneider).

(Latin " carinatus " keeled, in allusion to its scales.)

The Saw-Scaled Viper.

Tamil : " surattai pambu " (coiled snake), " pul surattai " (grass coiled snake).

Synonymy.—*Pseudoboa carinata, Boa horatta, Scytale bizonatus, S. pyramidum, Vipera carinata, V. echis, Echis ziczac, E. arenicola, E. frenata, E. superciliosa, Toxicoa arenicola.*

History.—Russell was the first to refer to the species in 1796 (Vol. I.), and he figured it very nicely on Plate II. of that work. Schneider christened it in 1801.

General Characters.—Head subovate. Snout very short, without canthus, rounded anteriorly. Eye large, the iris golden yellow, and the pupil vertical. Nostril small, placed rather high, lying between the nasals. The commissure of the mouth is viperine; the upper lip presenting a downward rounded contour, corresponding to the position occupied by the fang when the mouth is shut. Neck markedly constricted. Body cylindrical, short, and stout, attenuating towards the neck, and also posteriorly towards the vent. It is very rough, especially so in the flanks from the keeled and serrate condition of its scales, dorsally lustreless, in striking contrast to the highly polished ventral aspect. Belly rounded. Tail short, about one-tenth to one-eleventh the total length.

Identification.—The following characters will distinguish it from other Ceylon snakes. The head is covered on the top with small scales throughout, and the subcaudal shields are entire. The serrated keels on the flanks are seen in no other snake, so that it is very easily recognized.

Colouration.—As in nearly all the vipers the colouration and markings are very variable. Mr. Boulenger* speaking of another viper (*Vipera ursinii*) says " I must observe that vipers generally vary so much, both individually and according to localities, that little reliance is to be placed for specific distinction on that character." This remark certainly applies to the saw-scaled viper.

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* Proc. Zool. Soc., Lond., 1893, p. 598

Usually the ground colour in the *echis* is a light shade of brown, buff, or tawny, and the markings are darker brown or even blackish. In sandy places, where I have usually met with it, it harmonizes wonderfully with its surroundings. Sir A. H. McMahon writes to me: "The Echis adapts itself to the colouring of the locality. I have found them of all shades of colour, from the lightest fawn in sand to almost black in dark rocky country." The body dorsally is more or less mottled or blotched with darker shades, sometimes with a decided regularity of pattern, more frequently, I think, irregularly distributed with no special arrangement. These marks may be so obscure as to be hardly noticeable in light specimens, or so heavily abundant that they form the predominating colour, when the specimen is deep umber or blackish. A light undulatory line in the flanks is nearly always more or less evident. The head often bears a light patch on the middle of the crown, which is frequently shaped like a dagger, a broad arrow, or the imprint of a bird's foot, and there is often a more or less conspicuous streak behind the eye. The belly is light, often whitish, and is more or less profusely specked, mottled, or spotted with darker, and often rufous, bistre, or ruddy tints. I have sometimes seen a pinkish band down the middle of the belly.

Habits.—(*a*) *Haunts:* It is essentially a desert snake, but occurs plentifully in semi-desert tracts where the soil, though sandy and poor, supports some sparse vegetation, so long as open patches intervene. In Delhi it appeared to be most plentiful on the ridge, where the broken and rocky nature of the ground afforded special facilities for concealment or retirement in the face of danger; but there are many waste sandy tracts where rocks do not occur where it thrives in great numbers. Blanford obtained 2 or 3 specimens in thin jungle about Ellore, and expressed surprise at finding a desert form like the *echis* in wooded country. It is not found in dense jungle, for the reason, I suppose, that its colouration in such an environment would no longer be protective, added to which it does not appear to need shade, enjoying as it does the fiercest rays of the tropical sun, and at the hottest seasons of the year. It may be seen lying in the sand exposed to

the full force of the sun, or may retire beneath stones, or into clefts and crannies of rock, so baked with the sun's rays that the hand cannot bear contact with them. Yet even under such conditions it seems to rely solely on the juices of the animals it eats for the moisture necessary to assuage its thirst. It sometimes takes refuge in holes in the ground, as I have good reason to know when digging along the burrows leading to the nests of the green bee-eater (*Merops viridis*). The sudden and unexpected introduction to this, or any other snake in such circumstances, detracts much from the pleasure of birds' nesting in this country.

I have occasionally known it come into the house. The late Mr. L. C. H. Young reported one which he found moving round his dinner table, and in Trichinopoly I once found one which had climbed on to the top of my verandah chick. I have one or two other records of the *echis* climbing.

(*b*) *Disposition:* This is the most vicious snake I know. Not only is it extremely apt to bite on the smallest provocation, but strikes out without hesitation and with great malice. These disagreeable traits in its character, and the extreme velocity with which it delivers its stroke, combine to make it a most dangerous reptile to meet unawares, or to have any dealings with when fully on the "*qui-vive*," either in effecting capture or whilst in captivity. The lightning-like rapidity with which it strikes, delivers its bite, and regains its former attitude, must be witnessed to be fully appreciated. The manner in which it exactly resumes the position it occupied before striking, which is characteristic, has left me sometimes wondering whether a stroke had been delivered at all, or my senses had deceived me.

(*c*) *Striking Posture:* This is very characteristic, and excellently described by Fayrer who says: "The echis is very fierce and aggressive—it is always on the defensive, ready to attack; it throws itself into a double coil, the folds of which are in perpetual motion, and as they rub against each other they make a loud rustling sound very like hissing . . . . It is very active, and can dart a considerable distance—a foot or more—to strike its prey: it is by far the most active and aggressive poisonous snake I have seen." Again he says

(p. 137) : "I may remind the reader that the *Echis carinata* is a very active and fierce little viper, very aggressive, minaceous, and irascible . . . . in striking the head was always erect, and the whole aspect and attitude was that of intense malice and mischief."

Mr. Millard alludes to the peculiar movement adopted by this viper in causing the friction of its scales, thus : "it has a curious habit of revolving in almost the figure 8 with its head always in the centre." Fayrer's* plate shows the attitude referred to by Mr. Millard very well.

The hissing noise and its production are among the most interesting features connected with this snake. From four to seven of the costal series above the penultimate row are peculiarly oblique. In these rows, and these only, the keels are serrated, and when the sides of the body rub against one another, the teeth on the opposing faces scrape together, producing a noise so like hissing, that the onlooker ignorant of the method in which the sound is really produced, may well be deceived. The volume of sound is doubtless very greatly intensified by the habit this snake possesses in common with many others of inflating itself under excitement. The result is the production of a column of imprisoned air within, which in this case acts as a resonant chamber. In Delhi I frequently saw a heap of these creatures alive in a ghurrah, brought to Major Dennys when he was collecting poison for the Indian Government some years ago. When the lid was lifted, several of these creatures, would excite themselves, and begin rubbing their flanks, with the result that the sound produced reverberating within the pot, sounded not at all unlike that of a boiling kettle, the effect being distinctly uncanny as no issue of steam accompanied it, and the chatty was cold.

(*d*) *Nocturnal or Diurnal:* It appears to be completely diurnal. I have very frequently seen it moving in the daytime, or reclining in lazy apathy with its head and part of its body issuing from some hole or similar retreat. It is always seemingly on the alert. I have at times too found it abroad under cover of darkness.

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* Thanatophidia of India, Plate XII.

(*e*) *Progression:* Many observers have remarked upon its activity. Mr. Millard wrote to me as follows: "It moves very rapidly, when it wishes to escape, by almost throwing itself from its tail." I have not seen the *echis* manifest such activity, but believe that many snakes can do so when making their utmost endeavours to escape. I have certainly seen Russell's viper do so. I can find no better way of describing the muscular effort than as a jump. As a rule, I have found the *echis* maintain its ground, and when closely approached start rubbing its flanks together with great assiduity.

(*f*) *Hissing:* Fayrer remarks that he thinks *echis* does not hiss. Whether it does so or not, no ordinary hissing, except perhaps that of Russell's viper, would be audible during the production of the loud false-hissing sound made by the friction of its serrate keels.

(*g*) *Hibernation:* In the Punjab the *echis* retires in the winter months, but some emerge even then from their quarters to bask in the heat of the sun.

(*h*) *Sloughing:* Fayrer noted on October 15 of some specimens he had in captivity "it is a remarkable thing that none of these *echis* have shed their epidermis since they came here three months ago."

Food.—Mr. Millard tells me those in captivity at Bombay fed freely on mice, centipedes, and scorpions, but he has also known them eat frogs, and on one occasion a locust. One swallowed another of the same species, which it subsequently disgorged. Two in the Madras Museum ate the frogs offered to them. Gunther says he never found anything but centipedes (*Scolopendræ*) in the stomachs he opened. Major O. A. Smith says those he had ate skinks with avidity. I have also known one in its natural haunts eat a gecko.

Foes.—Though such a truculent little reptile, it is sometimes overpowered by creatures one would expect it to vanquish, or at least to hold its own with. Mr. Boulenger says, on the authority of Mr. Mountford, that the Sind krait (*Bungarus sindanus*) is reported to frequently eat the echis. Jerdon records a sand snake (*Psammophis condanarus*) having eaten one, and Elliot reports a case where the common house rat killed three *echides* without suffering in any way. He

says: "The snakes each time struck at the rat savagely and repeatedly, but no trace of blood could be seen on the animal." These creatures were all in captivity at Guindy near Madras. Major O. A. Smith told me of one that was strangled by John's earth snake (*Eryx johni*).

Breeding.—(*a*) *The Sexes :* My notes throw no light on any disparity in the sexes, nor have I observed any difference in the length or lepidosis of the sexes.

(*b*) *Method of Reproduction :* The *echis* is viviparous in habit. Major O. A. Smith witnessed the birth of three young on August 6, 1907, in Multan. The mother had been three weeks in captivity. The first snakeling was born in membranes at 10.40 A.M., and took "a long time" to burst them and force its way out. The second born in membranes at 11.12 A.M. took four minutes getting free. The third, also born in membranes, was discharged at 11.25 A.M., began struggling at 11.50 A.M., and was free at 11.53 A.M. It was observed that in trying to free themselves they exerted pressure with their snouts against the membrane. After their birth "a lot of jelly-like substance, whitish in colour, was passed out," which, I think, may have been a non-fertile egg. During birth it was noticed that a globular bag containing orange-coloured fluid first gained exit, increasing in size, and expanding the cloaca till the rest of the bag containing the coiled embryo escaped. The young were "proximately 112 mm. (4½ inches) long."

(*c*) *Season :* Mating evidently takes place during the winter months when the *echis* is hibernating.

I had a gravid female with young ready to be born, length 140 mm. (5½ inches), from Lahore in June.

Candy says that at Ratnagiri he ascertained after careful inquiry that the young are born in April, May, and June. Colonel Bannerman told me of two broods produced at Parel in June, and one in July. One in Regent's park, Miss Hopley tells us, produced young in July. A captive specimen in my vivarium at Trichinopoly gave birth to her brood in August. Sir A. H. McMahon told me he came across a lot of young *echides* in August at Quetta, and had heard of others found in the same month. Major Smith's brood were born in August

at Multan. A brood of 15 was deposited in the Madras Museum on June 18, 1918, and another of 5 on November 10, 1917.

(*d*) *Period of Gestation:* This is not known, but a note in the Bombay Natural History Journal (Vol. XX., page 230) by Colonel Bannerman implies that it is over six months. Infertile eggs were laid on July 8, and the last of six *echides* in this case was acquired on February 10. The writer does not say, however, that none of these were males, and there is therefore considerable doubt in my mind as to the intended significance of his remark.

Growth.—(*a*) *The Young:* From three to fifteen are produced in one brood. The young vary from 115 to 152 mm. (4½ to 6 inches) in length when born. One of a brood deposited in the Madras Museum measured 137 mm. (5½ inches). Those born in my vivarium lay in a confused heap apart from the mother, who took no notice of them.

(*b*) *Early Life:* I have not been able to follow the broods of successive years.

(*c*) *Maturity:* The Lahore gravid female sent to me was only 355 mm. (1 foot 2 inches) long, so if the *echis* grows at the same rate as most snakes, and doubles its length in the first year of life, this specimen was not much more than a year old.

(*d*) *Maximum Length:* Most specimens are less than 457 mm. (1 foot 6 inches) in length, and they rarely attain to 610 mm. (2 feet). The largest I know of are one reported by Mr. Colon from Jodhpore, which measured 760 mm. (2 feet 6 inches), and one by Lieut.-Colonel Major, which taped 788 mm. (2 feet 7 inches).

Poison.—(*a*) *The Fangs:* These are canaliculate, and usually there are two operative fangs in each maxilla. They are remarkably long for the size of the snake. Those in a skull in my collection, prepared from a specimen 380 mm. (1 foot 3 inches) in length, measure 5 mm. ($\frac{3}{16}$ of an inch).

b) *The Glands:* These are roughly almond-shaped and placed behind the eye. The surface is corrugated, unlike the cobra's glands, which are smooth.

(c) *Physical Characters:* Stevenson says when dried the venom assumes the character of amber-coloured scales.

(d) *Yield:* As the poison in its liquid form varies much in its degree of concentration, it is always measured by the weight of the desiccated residue. This is found to vary considerably, the amount depending on the vigour of the snake. A freshly caught specimen yields much more than one long in the vivarium. Acton and Knowles found the average yield for 57 snakes, varying in length from 9 to 18½ inches, was 18·8 mgms. The maximum yield was 72·2 mgms. from a specimen 18½ inches long.

Stevenson expressed 3 or 4 drops from the glands of one snake in vigorous health.

(e) *Amount injected at one Bite:* Acton and Knowles estimate that about 12·3 mgms. are injected at one bite, or more than twice the lethal dose for an adult.

(f) *Toxicity:* Compared with cobra poison *echis* venom is nearly five times as toxic according to Acton and Knowles. It is sixteen times more potent than the venom of Russell's viper.

(g) *Rapidity of Absorption:* Acton and Knowles's experiments show that the absorption is so rapid that if a lethal dose has been discharged into the wounds, sufficient will have entered the blood stream in twenty minutes to cause death. This means that local remedies, and even amputation performed later than twenty minutes, will not avert death if a lethal dose has entered the systemic circulation.

(h) *Lethal dose for Man:* Acton and Knowles estimate that the lethal dose in the human adult is about 5 mgms. This is based on the assumption that man is as susceptible as the monkeys upon which they experimented.

(i) *Uncertainty of the Effects:* The yield varies considerably even in adult *echides,* and this probably accounts for the fact that a great many bitten subjects escape death. One specimen, 362 mm. (15½ inches) long, yielded 1·4 mgms., and another of the same length 26·8 mgms. One 470 mm. (18½ inches) long yielded 40·6 mgms., whilst another of the same length furnished 72·5 (Acton and Knowles). In 36 experiments conducted by Acton and Knowles, where rats were bitten by

echides, one died in 1 hour and 42 minutes, thirty-one died between 2 and 12½ hours, two in 44 hours, and two survived. Dr. Imlach, speaking of Shikarpur, where *echides* are very abundant, estimated that about 20 per cent. of the snake-bitten cases died. Later, Vidal, speaking of Ratnagiri, where the saw-scaled viper is incredibly numerous, estimated that about 20 per cent. of *echis* casualties proved fatal. Acton and Knowles think that about 40 per cent. of bitten subjects recover without treatment.

(*j*) *Toxins*—

(1) Toxins operating on nerve cells :

(*a*) A depressor acting on and paralysing the vasomotor centre (?) (Fraser and Gunn (?)).

(*b*) A depressor to nerve cells generally (Lamb and Martin), but insufficient to cause paralysis other than that of the vasomotor centre.

(2) Agents affecting the constitution of the blood :

(*a*) An anti-clotting ferment (Fraser and Gunn).

(*b*) "Hæmolysin," destructive to red blood cells (Fraser and Gunn).

(3) "Hæmorrhagin" damaging the lining membrane of blood vessels, is probably present.

(4) A depressor to cardiac muscle (Fraser and Gunn).

(*k*) *Analysis of the Action of the Toxins*—

(1) (*a*) A depressor to the vasomotor centre is probably present to explain the reduced blood pressure and cardiac weakness noted by Fraser and Gunn. The same phenomena are seen in *daboia* poisoning, which, Rogers demonstrated, were due to a paralysis of the vasomotor centre, early death from heart failure ensuing.

(*b*) This toxic element accounts for the great depression of vitality seen in *echis* poisoning. It is insufficient to cause paralysis.

(2) (*a*) The anti-clotting ferment accounts for the defective clotting capabilities produced in blood, and in conjunction with (3) for the hæmorrhages, which are so frequently seen.

(*b*) "Hæmolysin" in this venom is relatively potent, and hence destruction of red blood cells is a prominent feature. This produces some respiratory embarrassment and contributes to the depression of vitality produced by (1) (*b*).

(3) "Hæmorrhagin" is relatively more potent in this than in any other of our Indian snake venoms. In conjunction with (2) (*a*) it causes profuse bleedings.

(*l*) *Symptoms of Echis Toxæmia:* The poison of the saw-scaled viper has no direct effect upon the central nervous system, except upon the vasomotor centre (as shown by Rogers), consequently paralyses are conspicuously absent, and the chief constitutional symptoms observed are indicative of cardiac weakness. In addition, the constitution of the blood is profoundly altered, and the blood vessels have their lining membrane damaged, with the result that hæmorrhages almost always occur. The local symptoms resemble those of Russell's viper (q.v., page 518).

In *echis* toxæmia the heart labours under great difficulties. Like colubrine venoms this powerfully depresses the vasomotor centre in the brain, producing a fall in blood pressure, and a weakening of the heart's pulsations. Fraser and Gunn have also demonstrated a direct weakening effect that this venom exerts on the cardiac muscle itself. By a destruction of the red blood cells an impoverished quality of the blood is supplied to the heart's muscle, which suffers again on this account. Further, the activity of the heart is lowered proportionately to the degree to which hæmorrhages occur. Over and above all these influences are the emotional ones, due to anxiety, fright, and pain. It is not surprising, therefore, that death is due to heart failure. Any attendant tendency to asphyxia that may present itself is brought

about indirectly by the cardiac weakness supplying insufficient blood to the respiratory centre, and not by any direct influence of the poison on the respiratory centre in the brain, or on the terminations of the phrenic nerves.

(*m*) *Illustrative Case:* Bite from *Echis*, 12 inches long. Death in 27 hours. Autopsy. Reported by Captain C. H. Reinhold, I.M.S. (*Indian Medical Gazette*, November, 1910).

At Hangu, on July 13, at 7 A.M., dhooly bearer R., age about 40, while removing a dhooly from a tent, was bitten by a snake on the outer side of the forearm, 3 inches above the wrist.

He at once went to the hospital assistant, and told him what had happened. The hospital assistant, with commendable promptitude, applied a ligature immediately above the site of the tooth mark, from which oozed two minute drops of blood, he then incised across the tooth marks, and removed semi-circular flaps of skin to the size of an 8-anna piece, induced free bleeding, and rubbed in crystals of permanganate of potash.

By this time the snake had been killed by some sepoys, and the hospital assistant went to see it; recognizing it as a poisonous one, he applied a further ligature round the fleshy part of the forearm of the man.

Since the hospital at Hangu is only a camp one, the patient was removed in a cart to the civil dispensary, and here, at 9 A.M., rubber ligatures, above and below the elbow, were substituted for the cloth bandages, and potassium permanganate re-applied.

No antivenene being available, it was not used.

The wound in the arm continued to ooze all day, but the patient complained of severe pain in the arm, which was attributed to the ligature, however, he managed to get some sleep.

At 5 P.M., there was considerable swelling of the arm, and severe pain complained of: as the general condition of the man remained satisfactory, it was decided to remove the ligatures.

At 7 P.M., the patient passed a diarrhœic motion in bed, but got up later to pass water and clean himself. There was no blood in the motion or urine, and active bleeding had ceased from the wound in the arm, the dressing being merely stained.

At 10 P.M., the patient complained of pain in the abdomen, and was given aromatic spirits of ammonia and cinnamon water.

At midnight, the pain in the abdomen was worse; patient described it as a burning sensation. There was no vomiting.

At 2 A.M., the patient passed a diarrhœic motion (no blood), going out, with assistance, to the latrine 20 yards away for the purpose. Patient had no sleep during the night, and was restless, complaining continually of the abdominal pain.

July 14, 7 A.M., the wound was dressed, there was no fresh bleeding, the patient was quite conscious, though the pulse was imperceptible at the wrist. It was not noticed that he was blanched or cold. He complained of thirst and drank *sherbet.*

There was no sign of any paralysis.

About an hour before death he became very restless and ceased to recognize his surroundings.

He died at 10 A.M., 27 hours after the accident. I saw the case first an hour after death; *rigor mortis* had not yet set in. There was some swelling of the left arm, and blisters above and below the elbow where the rubber ligatures had been applied.

A *post mortem* examination was made at 6 P.M., 8 hours after death.

Rigor mortis was well established.

The wound in the arm was circular and about the size of an 8-anna piece, it had penetrated well into the connective tissue, but was not deeper. There was no sanious discharge from the wound, though the blood stains on the dressing were watery.

Lungs: Emphysematous and anæmic, old pleuritic adhesions on the left side.

Heart: Left ventricle strongly contracted and empty, right ventricle engorged with blood. The blood was quite fluid and notably light coloured; there was no trace of clotting.

Abdomen: No peritonitis or petechial hæmorrhages; the coils of intestine were distended with gas, and the omentum was anæmic. The bladder was strongly contracted, and the urine not blood stained.

Liver: Normal, anæmic.

Kidneys: Normal, anæmic—the capsule stripped easily.

Spleen: Normal, small.

An enormous retro-peritoneal hæmorrhage distended the left side of the abdominal cavity, extending from the diaphragm to the brim of the pelvis, but not crossing the middle line. The blood forming the hæmorrhage was dark, and had formed a curiously tough stringy clot, which was not easily broken up. It was impossible to discover what vessel was the source of bleeding; the arterial system generally was not atheromatous, and the vessels of the kidney did not show any gross degenerative changes. I satisfied myself that the hæmorrhage had no connection with the spleen or kidney (inquiries as to whether he had fallen or sustained any injury subsequent to the snake-bite produced no evidence of trauma).

I examined the snake which bit this man, and identified it as an *Echis carinata*, 12 inches long; this has subsequently been kindly confirmed for me by the Bombay Natural History Society.

(*n*) *Interval before Death:* The interval before death necessarily depends upon the dose. Where a death is due to syncope arising from the depression of the heart, or a sudden profuse hæmorrhage, this may occur in 24 hours or even less. Where the case lingers on, and death is due to exhaustion from recurrent hæmorrhages, the fatal hour may be postponed for a week or even two.

(*o*) *Treatment:* No antivenene is available for this form of ophitoxæmia. It has been prepared on a small scale, and its efficacy proved by Stevenson. In the absence of an antidote, treatment must be symptomatic. Recourse must be had to Bayliss' fluid intravenously, $Ca\ Cl_2$ intramuscularly, and the other measures advised to combat syncope and hæmorrhage as advocated under the treatment of Russell's viper.

Lepidosis.—(*a*) *Typical—Rostral*. Touches six shields; the rostro-labial sutures subequal to the rostro-nasals, and about twice the rostro-internasals. *Internasals:* Two, small; divergent posteriorly. *Supraoculars:* Replaced by small scales. *Nasals:* Entire or divided into two by a suture running back from the nostril; in contact with the rostral and the 1st labial. *Suboculars:* Two rows of scales intervene between the eye and the supralabials. *Supralabials:* Ten to twelve; the 4th largest; none touching the eye. *Infralabials:* Four; the last touching three or four scales behind. *Sublinguals:* One pair, touching four infralabials. (Fig. 93.)

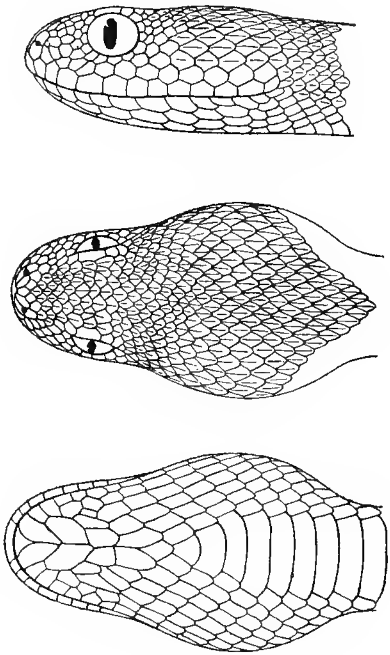

FIG. 93.—Echis carinatus.

(× $\frac{1}{3}$.)

Costals : At midbody. The median rows rectiform, with tylotose keels ; breadth of scales about two-thirds their length, half those of the ultimate row. (Fig. 94.) Four to seven rows

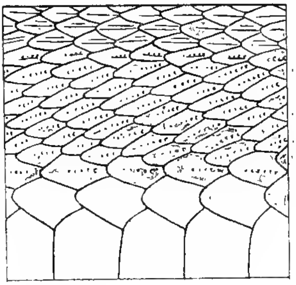

FIG. 94.—Scales of Echis carinata. Notice the oblique rows and their serrate keels.

above the penultimate oblique, with serrate keels, breadth about half their length. Penultimate row rectiform, keeled, in contact with three scales above ; scales as broad as long. Ultimate row enlarged, rectiform, keeled to a variable extent posteriorly, breadth of scales half or less than half their length. In 25 to 37 rows in midbody. Two heads-lengths behind the head the rows are 23 to 31, two heads-lengths before the vent, 27 to 21. *Supracaudals :* In odd rows ; keeled to tip of tail. *Ventrals :* 132 to 195 ; rounded. *Anal :* Entire. *Subcaudals :* 21 to 48 ; entire. (Fig. 95.)

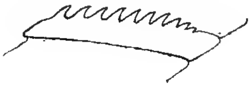

FIG. 95.—To show serrate keel of scale of Echis carinata.

(*b*) *Anomalies—Supralabials:* Sometimes the third is the largest of the series. *Infralabials:* Sometimes only three.

Dentition.—From three skulls in my collection. *Maxillary:* Two canaliculate fangs placed side by side. *Palatine:* 1 or 2; a short edentulous space, that would take one tooth, anteriorly and posteriorly. *Pterygoid:* 17 to 21; posterior two-fifths edentulous. *Mandibular:* 15 to 19.

Distribution.—(*a*) *General:* North Africa as far South as Somaliland on the eastern side. South Asia from Mesopotamia in the west, Peninsular India, except the Ganges valley and a small tract of country on the Malabar Coast, west of the hills and south of about the 15° parallel. Northern Ceylon.

(*b*) *Local:* It is a denizen of the plains, but ascends to a considerable elevation in the hills. It is common on the Mysore plateau at 3,000 feet. On the North-west Frontier it occurs up to about 6,000 feet. In Ceylon it occurs only in the northern part. Ferguson records it from Mullaittivu, with the remark that about a dozen specimens were procured for him there.

It is a common snake in the plains of India, and especially common in certain tracts. Vidal says that at Ratnagiri Government rewards were paid on 225,721 *echides* on an average during six years. When the reward was raised tentatively from six pies to two annas per head 115,921 were paid for in eight days!

Sub-family 2 **CROTALINÆ.**

(Named from the type Genus *Crotalus.*)

Identification.—Loreal pit present.

Distribution.—Asia, North and Central America.

Arranged in four genera, of which two are represented in Indian limits, and both in Ceylon.

Genus ANCISTRODON.

(Greek "agkistron" a hook, and "odous" tooth.)

General Characters.—The species are small, varying from about 18 inches to 3 feet in their adult state. The head is flat, subtriangular in shape, and broadest about midway between the eye and the neck. The snout is moderate in length, attenuated towards the tip, has a pronounced canthus, and may or may not have an eminence or scaled appendage on the anterior part above. A loreal pit is present between the eye and the nostril. The eye is moderate, being about half the length of the snout; the iris speckled with ruddy gold, and the pupil vertical. The nostril is pierced near the middle of the nasal shield. The neck is much constricted. The body is moderate in length, cylindrical, and robust. The belly is rounded. The tail is short, being about one-sixth to one-eighth the total length.

Identification.—The combination of loreal pit and enlarged shields on the head will establish the identity of the genus in Ceylon.

Habits.—Terrestrial, partially, if not wholly, nocturnal; sluggish; viviparous, except *A. rhodostoma;* poisonous, but rarely fatal to man.

Food.—Mammals, lizards, batrachians, reptilian eggs, and sometimes scolopendræ.

Lepidosis.—*Rostral:* Touches six to nine shields; the rostro-nasal sutures twice the rostro-labial. *Internasals:* Two more or less in contact. *Præfrontals:* Two, sometimes touching the internasals in front and the frontal behind, sometimes not. *Frontal:* Touches six to eight shields; the fronto-supraocular sutures greater than the fronto-partietals. *Supraoculars:* As long or longer than the frontal, as broad or

broader than the frontal along a line connecting the centres of the eyes. *Parietals :* As long or longer than the frontal. *Nasal:* Entire. *Supraloreal:* Present. *Loreal:* One or more forming the floor of the loreal pit. *Præoculars :* Three, the median and lower divergent to border the loreal pit. *Postoculars :* One or two. *Suboculars :* One or two. *Temporals :* A large lower anterior, in contact with one or more other subequal shields behind it, bordering the supralabials. *Supralabials :* Usually seven, the 1st only touches the nasal, one or more frequently, none touch the eye, 4th and 5th usually touching the anterior temporal. *Sublinguals :* One pair, touching two or three infralabials. *Infralabials :* Three or four, the last touching three or four scales behind.

Costals : Longer than broad, rectiform, with broadly rounded apices, keels feeble or strong in most of the median rows ; apical pits present, obscure, in pairs. Vertebrals not or slightly enlarged, the breadth of the scales subequal to their length, subequal to those of the ultimate row. Ultimate row enlarged, the breadth of its scales subequal to their length. In 17 to 27 rows. The number usually remains the same until shortly before the vent, where it reduces by two. *Supracaudals :* In even rows. *Ventrals :* Rounded ; less than 175. *Anal :* Entire. *Subcaudals :* Divided ; less than 65.

Dentition (Indian Species).—The *maxilla* carries two canaliculate fangs placed side by side. The *palatine* is short, and the posterior third edentulous, teeth isodont; 3 or 4 in number. The *pterygoid* is edentulous in about its posterior half ; teeth scaphiodont; 8 to 18. The *mandibular* teeth are scaphiodont, and number 11 to 19.

Distribution.—At least eleven species are known which inhabit Southern Asia from the borders of the Caspian sea to China and Japan ; the Malayan Archipelago as far East as Batavia ; North and Central America. Three species occur within Indian limits, and two of these occur in Ceylon, viz., *A. hypnale* and *A. millardi.*

ANCISTRODON HYPNALE* (Merrem).

(Greek " hupnaleos " the soporific effects of poison.)

Merrem's Hump-nosed Viper.

Sinhalese: " kunakatua," and " polong-telissa " (Ferguson). (Not " carawala," as stated by Dr. Davy in his History of Ceylon.)

Synonymy.—*Coluber nepa, Cophias hypnale, Trigonocephalus hypnale, T. halys, T. zara, Trimesurus ceylonensis, Hypnale nepa, H. affinis, Ancistrodon millardi.*

History.—First depicted by Seba in 1734 in his Thesaurus (Plate XXXIII., Fig. 5) under the name " hotambœia." Laurenti's description of *Coluber nepa* is too scanty to identify the snake alluded to with any certainty.

General Characters.—A small snake, only growing to about 18 inches. The head is flat, and broadest about midway between the eye and the neck. The snout is moderate in length, gradually decreasing in breadth, with angular canthus, and a pronounced hummock of variable length on the nose. There is a loreal pit on the side of the face. The eye is moderate, with a vertical pupil, and an iris speckled with ruddy gold. The nostril is small, and pierces about the middle of the nasal shield. The neck is very evident. The body is short and thick, and cylindrical in form. The belly is rounded. The tail is short, being about one-eighth or one-ninth the total length.

Identification.—The scale rows 17 in midbody, together with the loreal pit, will serve to distinguish this and the next species from all other species in Ceylon. From *millardi* it is to be known by the ventrals being 136 to 157, the supra-oculars being broader than the frontal and as long as the parietals.

Colouration.—Very variable. The ground colour is grayish or dirty white, and is heavily powdered and mottled with brownish or purplish-brown of varying degrees of intensity.

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* In previous papers I have wrongly referred to this as *millardi*, and *vice versâ*. I assumed that the species so common at Hakgalla was the *hypnale* of Merrem, but I find now that I have seen Merrem's description, that I was mistaken.

There is always a series of large, ovate, lateral, purplish-brown spots, which may alternate with those of the other side or correspond to them. In the latter side there may be some confluence of the spots. The head is powdered like the back. A dark postocular stripe runs to the gape, and has a light stripe above it. The upper lip is deep purplish-brown. The under parts are grayish, heavily peppered and spotted with purplish-brown of varying degrees of intensity. The tip of the tail is uniform ruddy or yellowish colour. Some specimens are very light in colour, others very dark.

Habits.—(*a*) *Haunts:* Appears to favour a heavy jungle environment, where its colouration would prove decidedly protective. Mr. Green tells me that it not infrequently climbs into the coffee shrubs, and that planters in some parts call it the "coffee polonga."

(*b*) *Disposition:* Mr. Green tells me that those he had in captivity were very sluggish. In its natural haunts it is quickly roused to anger, and strikes without hesitation, so that casualties are not uncommon. Dr. Davy describes it as active and fierce.

(*c*) *Striking Posture:* When confronted it lies prone in a convoluted mass, with the head raised and retracted, flattens itself to the ground, and often vibrates its tail. Dr. Davy says when provoked it hisses, and darts its head forward with great rapidity at the irritating object, and wounds almost to a certainty.

(*d*) *Nocturnal or Diurnal:* It is frequently encountered in the day, but whether on the move or not I am not able to say. Possibly the gloom of heavy jungle furnishes a light congenial to it by daylight.

(*e*) *Progression:* Abercromby says that when disturbed it proceeds by a series of short jumps.

Food.—I found a mouse had been eaten on one occasion, and masses of hair, presumably the remains of mice, were found in the cloacæ of two others. I found lizards had been ingested on two occasions, and a frog once.

Breeding.—(*a*) *The Sexes:* The sexes grow to a similar length. The tail is rather longer relatively in the male, and the terminal scute is longer in the male, and slightly turned up.

(*b*) *Method of Reproduction:* It is viviparous.

(*c*) *Season:* My breeding events throw no light on this question.

(*d*) *Period of Gestation:* Not known.

Growth.—(*a*) *The Young:* The length of the young when born is not accurately known. Gunther extracted embryos from a gravid female that measured 127 mm. (5 inches) in length, and remarked that they were perfectly developed. The brood varies from four to ten. I have had many gravid specimens.

(*b*) *Early Life:* I am unable to follow the growth of my specimens as no dates of capture were given. My smallest specimen was 158 mm. ($6\frac{1}{4}$ inches) long.

(*c*) *Maturity:* My smallest gravid females were both 285 mm. ($11\frac{1}{4}$ inches) long.

(*d*) *Maximum Length:* It does not often attain to 380 mm. (15 inches) in length. The largest known to me is that recorded by Gunther, viz., 483 mm. (19 inches).

Poison.—The venom is probably never fatal to man, in spite of what Tennent says to the contrary. It is more than likely cases may end fatally, however, from emotional causes, as in the case of harmless snakes, where the bitten subjects die of fright. Mr. Green has told me that every year Ceylon statistics show one or more deaths from the harmless little lizard, *Mabuia carinata,* and this is in consonance with what one knows in India.

I have several records of casualties in the human subject from this little viper, and in all the local signs were but moderate, and probably as much to be attributed to the treatment, as to the poison.

Dr. Davy experimented on the lower animals with the following results :—

(1) A pup two months old was bitten. In less than two minutes there was local swelling and oozing of blood from the wounds. The swelling increased, and the pup grew very sick. Forty-eight hours later symptoms had abated, but the wound sloughed badly.

(2) Another pup was bitten the same day by the same snake. There was immediate swelling, and ichorous discharge from

the wounds. It grew very sick, and developed bloody stools. Three days later the pup was well, but the wound sloughed.

(3) The next day the same snake bit a fowl above the left eye. The bird died four days later.

(4) The next day the same snake bit a half-grown fowl in the comb. The bird was sick twelve hours later, but recovered.

(5) A month later it bit a half-grown fowl in the eye. The bird sickened, but had recovered in twenty-four hours.

(6) A fortnight later it bit a bull-frog in the head, and the frog succumbed in five hours.

These experiments serve to show that the poison is not very virulent, but evidently an intense local irritant. In the human subject most of the casualties were treated by ligature and permanganate of potash or carbolic acid. The drugs would mask any pain caused by the poison, and the ligature would produce a swelling over and above that attributable to the poison, so that there is nothing definite to learn from these casualties. No constitutional effects were observed in any of these cases.

Lepidosis.—(*a*) *Typical :* The rostro-nasal sutures are greater than the rostro-labial. The hump on the nose varies much in length, and is covered by from 4 to 12 small scales. *Internasals :* A pair, not or barely in contact ; completely separated from the præfrontals by a transverse series of scales. *Præfrontals :* A pair, completely separated from the frontal by a transverse series of small scales. *Frontal :* Touches eight shields ; the fronto-supraocular sutures are longer than the fronto-parietals. *Supraoculars :* Length subequal to the frontal ; as long as the parietals ; breadth greater than the frontal along a line connecting the centres of the eyes. *Parietals :* As long as the frontal. *Nasal :* Entire. The floor of the loreal pit is either formed by the upper part of the 2nd supralabial, or by a scale or scales independent of the 2nd supralabials. *Præoculars :* Three ; the median and lowest divergent to border the loreal pit. *Postoculars :* Two ; the lower larger. *Temporals :* Three or more ; the lowest large. *Suboculars :* One or two. *Supralabials :* Seven ; the 1st only touching the nasal, none touching the eye, and the 4th and 5th the lowest

temporal. *Infralabials :* Three, all or only first two touching the sublinguals.

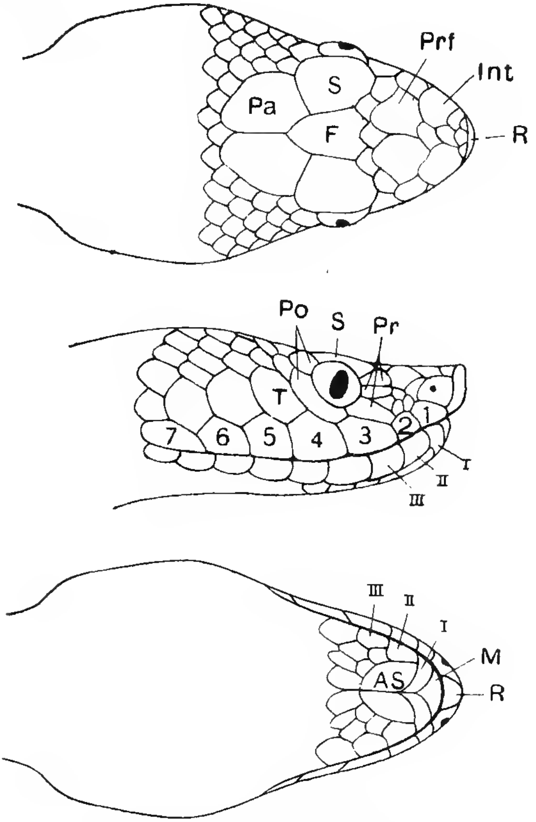

FIG. 96.—Ancistrodon hypnale.
(× 2.)

Costals : Rectiform, about as broad as long, with rounded apices; obtusely keeled. Vertebrals slightly enlarged, the breadth of the scales equal to their length, and equal to those of the ultimate row. Ultimate row slightly enlarged, the breadth of the scales about equal to their length. In 17 rows two heads-lengths behind the head, 17 in midbody, and 17 or 15 two heads-lengths before the vent. The row absorbed is the

fourth above the ventrals. *Supracaudals :* In even rows. *Ventrals :* Rounded ; 136 to 153 in males, 139 to 157 in females. *Anal :* Entire. *Subcaudals :* Divided ; 36 to 47 in males, 30 to 43 in females. If the ventrals and subcaudals are taken together the range is 175 to 198.

(*b*) *Anomalies :* The supralabials are rarely eight or nine. Some of the subcaudals are sometimes entire.

Dentition.—From seven skulls in my collection, five of which are from Ceylon. *Maxillary :* A pair of canaliculate fangs. *Palatine :* 4. *Pterygoid :* 13 to 19. *Mandibular :* 16 to 19 (? 21).

Distribution.—(*a*) *General :* Hills of Western Peninsular India, hills and low-country in Ceylon.

(*b*) *Local :* It is dubious whether the snake referred to by Haly, as common in the hills and low-country, is this species or *millardi*. The same remark applies to Willey who reported it common at Dumbara and Nanu-oya, Pearless at Badulla, and Abercromby around Anuradhapura. I have examined 48 specimens. Specified localities are Galle, Kandy, Veyangoda, Mullaittivu, Maduikele, and Uva Patnas. In India I have had specimens from the Western Ghats, Karwar, Anamalais, Nilgiri, Wynad, and Cochin hills.

ANCISTRODON MILLARDI (Wall).

(Named in honour of Mr. W. S. Millard, Hon. Secretary of the Bombay Natural History Society.)

Millard's Hump-nosed Viper.

Synonymy.—*Ancistrodon hypnale** (part).

History.—Described by me in 1908 in the Bombay Natural History Journal (Vol. XXVIII., p. 792).

General Characters.—Much like *hypnale* in most particulars. It is a small snake, growing to about 18 inches. Head flat and broadest about midway between the eye and the neck. Snout moderate in length and attenuating to the tip. An angular canthus is present, a more or less pronounced elevation on the top of the nose, and a loreal pit in the side of the face before the eye. Eye moderate, with vertical pupil, and an iris speckled with ruddy gold. Nostril small, and round,

* Until I described it specimens had been identified as *hypnale*.

piercing the nasal shield near its centre. Neck markedly constricted. Body short, thick, and cylindrical in form. Belly rounded. Tail short, accounting for about one-eighth to one-ninth the total length.

Identification.—The scale rows 17 in midbody, together with the loreal pit, will distinguish this from all other Ceylon snakes, except *hypnale*. From *hypnale* it is distinguished by the ventrals numbering 116 to 138 and subcaudals 27 to 39.

Colouration.—Dorsally the ground colour is a light brown or chestnut (as applied to a horse), variously powdered and mottled with darker tones. The most usual and conspicuous feature is the series of large oval spots down each side of the body. These reach the spine above, and may be confluent with those of the opposite side. Below, they nearly reach the ventrals. In some the lower halves of these are obsolescent, and the spots converted into semilunes. There is a series of large spots low down in the flanks. The belly is dirty white or grayish, heavily powdered with red and chocolate dots intermixed. The head is very strikingly ornamented. The chin and lower lip are blackish or chocolate, and the latter has a pair of pure white spots posteriorly. The same hue is continued on to the upper lip. Before the eye this terminates abruptly half way up the lore. Behind the eye the sharply defined limit of black is bordered by a thin line of white. Above this there is a pinkish suffusion, merging into the grayish hue that covers the whole of the crown. Specimens vary very much, some being very light in colour, with subdued powderings and mottlings, others dark with bold powderings and mottlings.

Habits.—(*a*) *Haunts:* All my specimens were in or near dense jungle.

(*b*) *Disposition:* None have reached me alive.

(*c*) *Nocturnal or Diurnal:* No comments were made by those who sent me specimens.

Food.—It subsists mainly on the little skink *Lygosoma taprobanense*. Many of these are evidently seized "a posteriori" and cast their tails, as the stomachs of many specimens contained nothing more. I have also found the tail of an agamoid lizard, apparently a *Calotes* in the stomach. On two

occasions I found small frogs had been ingested, and twice a snake of the species *Aspidura trachyprocta.* It also frequently feeds on soft-shelled eggs, which appeared to me lacertine, but which may have been ophidian. In some instances the contents of these eggs had been completely absorbed, without any visible breach of continuity in the shell, which was empty, collapsed, and longitudinally compressed. The shell resists the action of the digestive juices, and is discharged in this state.

Breeding.—(*a*) *The Sexes:* Of 26 specimens collected for me at Hakgalla, 10 were males and 13 females. The adult males were easily picked out from the females, by their tails being bent round ventrally like a shepherd's crook. The male claspers, as in other vipers, are bifid on each side, and surmounted by a formidable array of falciform cartilaginous processes.

(*b*) *Method of Reproduction* It is viviparous in habit.

(*c*) *Season:* The only available date is that of eggs in an early stage of development in a female killed on May 16 at Hakgalla.

(*d*) *Period of Gestation:* Not known.

Growth.—(*a*) *The Young:* Exact length not known. My smallest specimen, 158 mm. (6¼ inches) in length, was killed in July.

(*b*) *Maturity:* Not known. My smallest gravid example was 240 mm. (9½ inches) long.

(*c*) *Maximum Length:* My longest specimen was a male 387 mm. (15⅛ inches). My longest female was 381 mm. (15 inches).

Poison.—Nothing known.

Lepidosis.—(*a*) *Typical—Rostral* The rostro-nasal sutures are fully twice the rostro-labial. A more or less pronounced hump on the snout is covered with 8 to 12 scales. *Internasals:* A pair, separated from one another, but touching the præfrontals behind. *Præfrontals:* A pair, in contact with one another; separated from the supraoculars by a row of small scales. *Frontal:* Separated from the præfrontal by three scales (which appear to be disintegrated parts of this shield); the fronto-supraocular sutures longer than the fronto-parietals. *Supraoculars:* Longer than the frontal; as broad as the frontal along a line connecting the centres of the eyes; three-fourths to four-fifths the length of the parietals. *Nasal:* Entire. *Supraloreal:* One; as large as the internasal. *Loreal:* One or more, lining the

floor of the loreal pit. *Præoculars :* Three ; the median and lower divergent to enclose the loreal pit. *Suboculars :* One. *Postoculars :* One or two. *Temporals :* Two ; the lower large. *Supralabials :* Seven ; the 1st only touching the nasal, 2nd rarely forming the floor of the loreal pit, none touching the eye, the 4th and 5th touching the lower temporal. *Infralabials :* Three ; all touching the sublinguals. *Sublinguals :* One pair.

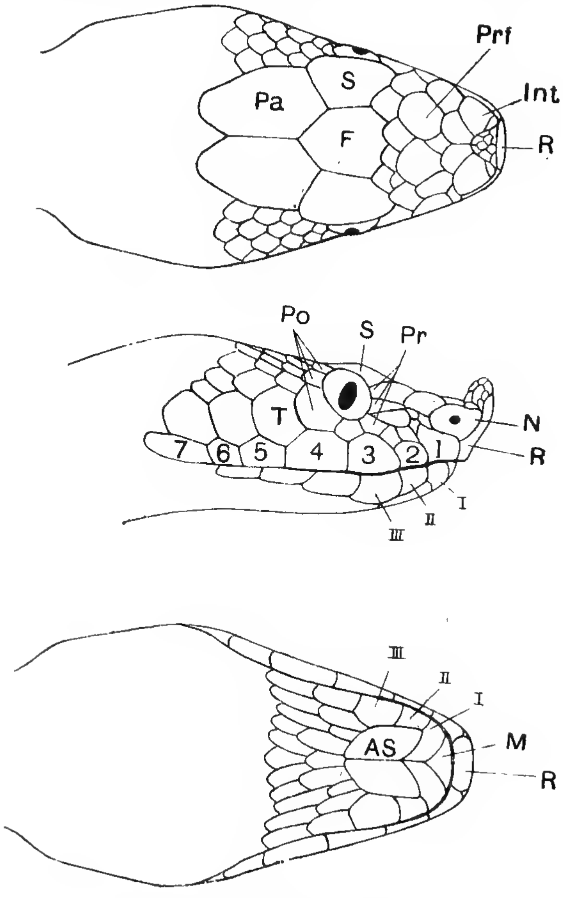

FIG. 97.—Ancistrodon millardi.
(× 2.)

Costals: Rectiform, feebly keeled, with rounded apices. Vertebrals slightly enlarged; as broad as long, as broad as ultimate row. Ultimate row about as broad as long. In 17 rows two heads-lengths behind the head, 17 in midbody, 17 or 15 two heads-lengths before the vent. The reduction of rows is effected by the absorption of the fourth row above the ventrals. *Supracaudals:* In even rows. *Ventrals:* In males 116 to 133; in females 121 to 138. *Anal:* Entire. *Subcaudals:* In males 29 to 39; in females 27 to 34. If the ventrals and subcaudals are taken together the range is 148 to 172.

(*b*) *Anomalies*—Sometimes only two infralabials touch the sublinguals. I have seen the parietals partially disintegrated.

Dentition.—I have no skull.*

Distribution.—(*a*) *General:* Ceylon.

(*b*) *Local:* Very common about Hakgalla. Of 47 examined, specified localities are Kandy, Ambewela, and Madulkele, and one labelled "Colombo" in the Government Museum. This last is the only example I have seen from the low-country.

I have seen no specimen from India.

Genus TRIMERESURUS.

("Trimeres" threefold, and "oura" tail. The name was suggested by a specimen in which some of the median subcaudal shields were entire, those at the base and apex being divided.)

General Characters.—The species vary from 1 to 8 feet in length. Head flat and broad, pear-shaped or subtriangular. Snout moderate or short, with pronounced canthus, not declivous, obtusely rounded anteriorly. There is a conspicuous opening—the loreal pit—between the eye and the nostril, leading to a shallow scale-lined chamber, the function of which is not known. Eye moderate to large, placed laterally, the iris usually heavily speckled with gold, pupil

* Since writing this I have acquired a skull from a specimen given to me by Dr. Pearson. The *Maxilla* carries 2 canaliculate fangs. *Palatine* teeth number 4. *Pterygoid* 14. *Mandibular* 17.

vertical. Nostril small, round, and pierced about the middle of the nasal shield. Neck very much constricted. Body moderately elongate, cylindrical or compressed, robust, attenuating considerably to the neck and more gradually towards the vent. Belly rounded. Tail prehensile in the arboreal species, short, or moderate ; varying from one-fifth to one-eleventh the total length.

Identification.—Known by the loreal pit and the whole crown of the head being covered with small scales. (Except *macrolepis*, which has large shields on the crown.)

Habits.—Terrestrial, arboreal. Usually sluggish, but fierce when roused.

Food.—Chiefly mammals, but also birds, lizards, and batrachians.

Breeding.—Viviparous, except the famous American bush-master (*T. mutus*) and the Himalayan (*T. monticola*).

Poison.—Poisonous, but mostly not fatal to man.

Lepidosis.—*Rostral :* Usually in contact with more than six shields. *Internasals :* Usually present ; when present, in contact or separated. *Supraoculars :* Usually well developed and entire, sometimes divided. *Nasal :* Entire or subdivided ; sometimes confluent with 1st supralabial ; in contact with the 2nd supralabial, or separated by small intercalary scales. *Præoculars :* Three ; the median and inferior divergent to border the loreal pit. *Postoculars :* One or two. *Suboculars :* One, two, or many. *Supralabials :* Seven to fourteen ; upper-part of the 2nd usually forming the floor of the loreal pit ; none touching the eye. *Sublinguals :* One pair ; in contact with three or four infralabials.

Costals : Longer than broad ; rectiform ; smooth or keeled ; in 13 to 27 rows. The vertebrals not enlarged. Ultimate row, with one exception (viz., *macrolepis*), enlarged. *Ventrals :* Rounded. *Anal :* Entire. *Subcaudals :* Divided.

Dentition.—*Maxillary :* A pair of large canaliculate fangs placed side by side. *Palatine :* Edentulous in *jerdoni*, and the posterior third or half edentulous in most of the other Asiatic species ; teeth large, isodont, and number from 2 to 6.

Pterygoid: edentulous for about half its length posteriorly; teeth scaphiodont, and number 5 to 20. *Mandibular:* teeth scaphiodont, and number 10 to 16.

Distribution.—South-east Asia, Central and South America. Of the forty species described, eleven are included in the Indian fauna, and one of these occurs in Ceylon, viz., *trigonocephalus.*

TRIMERESURUS TRIGONOCEPHALUS (Daudin).

(Greek "trigonon" a triangle, and "cephale" the head.)

The Ceylon Pit-viper.

Sinhalese: "pala polonga" (Ferguson). *Tamil:* "pachi virian" (green viper), and "kopi virian" (coffee viper) (Abercromby).

Synonymy.—*Coluber capite-triangulatus, Vipera trigonocephala, Cophias trigonocephalus, C. nigromarginatus, Trigonocephalus nigromarginatus, Megæra trigonocephala, M. olivacea. Bothrops nigromarginatus, Trimeresurus trigonocephalus.*

History.—First referred to by Lacépede in 1789, who also figured it. It received its specific title from Daudin in 1803.

General Characters.—Head flattened, broad, and roughly pear-shaped; broadest about midway between the eye and the neck. Snout short, with pronounced canthus, not declivous, broadly rounded terminally. Eye moderate in size, with golden iris, and vertical pupil. Neck very much constricted. Body moderately elongate, cylindrical, and robust. Belly rounded. Tail prehensile and rather short, being about one-sixth the total length.

Identification.—It is the only Ceylon snake with a loreal pit, and the whole crown covered with small scales. If the head is broken it will be known by its scale rows counting 19 two heads-lengths behind the head, 19 at midbody, and 15 two heads-lengths before the vent, and the vertebrals not being enlarged.

Colouration.—Dorsally it is green of various shades, variously mottled, and variegated with black. The markings in many specimens are disposed so as to form more or less distinct cross-bars. In others a series of round twin-spots pass down each

side of the spine, specially conspicuous in the young. Some are very heavily variegated, others very lightly, and others again are a uniform green. The top of the head is marked like the back. There is a conspicuous dark stripe from the eye to the gape. The end of the tail is blackish. The belly is greenish, the edges of each ventral lighter green or yellowish. Beneath the tail blackish mottlings intensify towards its tip.

Habits.—(*a*) *Haunts :* It is completely arboreal, and harmonizes so well with its foliaceous environment that it usually escapes detection until it moves. It is not infrequently met with in the coffee and tea bushes by estate coolies.

(*b*) *Disposition :* Appears to be phlegmatic, and not easily roused to anger.

(*c*) *Striking Posture :* It usually lies prone along a branch, with its tail and part of the hind body wreathed round its support. The head and forebody are raised and retracted, and then straightened to their full limits as the snake darts at its object. The tail is specially adapted for maintaining a grip, so that the snake does not fall, however vehement its thrust. A very considerable part of the body is freed when striking. The stroke is not very rapid, and could, I think be avoided if one was aware that it was impending. After the stroke, the body is again retracted in sinuous curves, often in a very leisurely fashion.

(*d* *Nocturnal or Diurnal :* Abercromby says it is nocturnal in habit, but it appears to be sufficiently alert by day, to await and profit by the advent of any unsuspicious quarry that comes within striking distance.

(*e*) *Hissing :* When roused and before striking it hisses audibly.

(*f*) *Sloughing :* Mr. Green tells me that a slough cast in his vivarium bore clear indications of the black variegation with which it was adorned.

Food.—Mr. Green found his caged specimens accepted lizards of the Genus *Calotes* and the Family *Geckonidæ*. I have found hair in the stomach and cloaca, and Gunther says he has removed tree-frogs and mice from the stomach.

Breeding.—(*a*) *The Sexes:* In a brood of 26 fœtuses there is a slight disparity in length in the sexes in favour of the male. The average of 15 males being 166 mm. (6⅔ inches), while that of 11 females is 162 mm. (6½ inches). Males in the same brood are more numerous. The claspers in the male are bifid organs, as in all the other vipers I know.

(*b*) *Method of Reproduction:* It is viviparous. In the Colombo Museum there are two unborn broods which I have critically examined.

(*c*) *Season:* This evidently covers a long period of the year. Both broods just referred to were in about the same stage of development, the fœtuses in each exceeding 150 mm. (6 inches) in length. One dam was killed at Neboda on January 12, 1911, and the other at Matale on July 1, 1904.

(*d*) *Period of Gestation:* Not known.

(*e*) *The Brood:* In one brood there are five fœtuses (2 males, 2 females, and one so damaged that the sex is not apparent). In the other there are twenty-six fœtuses (15 males and 11 females).

Growth.—(*a*) *The Young:* The newly-born snakeling will probably prove to be about 175 to 190 mm. (7 to 8 inches) long. Unborn fœtuses with the male genitalia still extruded, but evidently close to the day of their birth, measured from 156 to 175 mm. (6¼ to 7 inches).

(*b*) *Maturity:* The measurements of the two prospective dams alluded to are unfortunately not on record.

(*c*) *Maximum Length:* Mr. Green recorded one 1,015 mm. (3 feet 4 inches) in length. Abercromby reports one the skin of which measured 1,320 mm. (4 feet 4 inches).

Poison.—Mr. Drummond-Hay wrote to me that a Burgher conductor on his estate was bitten in the hand by a well-grown specimen. The hand swelled up at once, but by evening the swelling was already subsiding, and the following day had nearly disappeared. Mr. Pearless wrote to me that a villager at Badulla was bitten by a green-tic through the finger, and was treated by a native doctor with poor results, as he was getting worse. Three days later, when Mr. Pearless saw him,

he was still in great pain, and the swelling extended to the shoulder. He rubbed in vinegar, and the man was able to walk two hours later, and recovered. It is evident from this last case that the local effects are sometimes severe. Mr. Green says there are no recorded cases of death or of serious illness from this viper. More reports of casualties would be most acceptable, especially if any constitutional effects are ever noticed.

Lepidosis.—(*a*) *Typical—Rostral:* Touches six shields; the rostro-nasal sutures subequal to the rostro-internasals, and twice the rostro-labials. *Internasals:* A pair; in contact with one another. *Supraoculars:* Large; divided into two subequal parts. *Nasals:* Entire or semi-divided; not confluent with the first supralabial. *Præoculars:* Three; the median and lowest divergent to enclose the loreal pit. *Postoculars:* Two or three. *Suboculars:* One; in contact with the 3rd supralabial and the lowest præocular. *Supralabials:* Nine or ten; the 1st and 2nd touching the nasal; the 2nd forming the floor of the loreal pit; none touching the eye. *Infralabials:* Three or four. *Sublinguals:* One pair. (Fig. 98.)

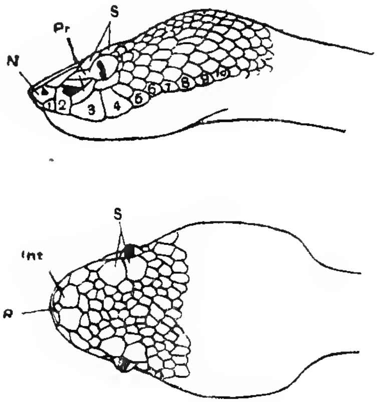

Fig. 98.—Trimeresurus trigonocephalus.

Costals : Longer than broad ; rectiform ; obtusely keeled in some of the median rows posteriorly. Vertebral row not enlarged, the breadth of its scales about two-thirds their length, and about three-fourths the breadth of the ultimate row. Last four rows rather broader than those above. Ultimate row broadest ; the breadth of its scales subequal to their length. The rows are 19 or 17 to behind midbody, and then reduce to 15. The reduction is effected by the absorption of the 4th or 5th row above the ventrals. *Supracaudals :* In even rows. *Ventrals :* 145 to 170. *Anal :* Entire. *Subcaudals :* 53 to 67.

(*b*) *Anomalies :* The internasals are sometimes in contact with the 3rd supralabial.

Dentition.—From one skull in my collection. *Maxillary :* Two large canaliculate fangs. *Palatine :* 5 ; edentulous in its posterior half. *Pterygoid :* 11 to 12 ; edentulous in its posterior half. *Mandibular :* 13 (? 12).

Distribution.—(*a*) *General :* Peculiar to Ceylon.

(*b*) *Local :* It is an up-country snake, and fairly common. Haly, however, says it occurs down to sea level. Mr. Drummond-Hay tells me it favours an elevation above 3,000 feet. Has been recorded from Matale, Punduloya, and Neboda. I have received specimens, or been given records, from Peradeniya, Kandy, Ratnapura, Balangoda, Yatiyantota, Moragalla, and Badulla.

Note.—Figures in italics indicate the page on which the description of the species is given. Figures in heavy type indicate the page on which the illustration is given.

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